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Proposed Amendment to Best Demonstrated Available Technology (BDAT)
Background Document for Wastes from the Petroleum Refining Industry
K048, K049, K050, K051, K052. Volume 18

(U.S.) Environmental Protection Agency, Washington, DC

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PROPOSED
AMENDMENT TO
BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)
BACKGROUND DOCUMENT
FOR WASTES FROM THE PETROLEUM REFINING INDUSTRY
K048, K049, K050, K051, K052

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1.0 INTRODUCTION

On August 8, 1988, the United States Environmental Protection Agency (EPA or Agency) established best demonstrated available technology (BDAT) treatment standards for the listed wastes identified in Title 40, Code of Federal Regulations, Section 261.32 (40 CFR 261.32) as K048, K049, K050, K051, and K052, wastes from the petroleum refining industry.¹ The wastes are listed as follows:

- K048 - Dissolved air flotation (DAF) float from the petroleum refining industry;
- K049 - Slop oil emulsion solids from the petroleum refining industry;
- K050 - Heat exchanger bundle cleaning sludge from the petroleum refining industry;
- K051 - API separator sludge from the petroleum refining industry; and
- K052 - Tank bottoms (leaded) from the petroleum refining industry.

Compliance with the BDAT treatment standards for these wastes is a prerequisite under 40 CFR Part 268 for placement of K048-K052 in land disposal units.

RCRA Section 3004(m)(1) states specifically that treatment standards are to be revised as appropriate. Therefore, EPA is not precluded from

¹These standards were promulgated in accordance with the amendments to the Resource Conservation and Recovery Act (RCRA) of 1976, enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984.

revising a treatment standard provided that rulemaking procedures are followed. EPA believes that revision of the promulgated K048-K052 treatment standards is appropriate at this time since additional treatment performance data became available to the Agency. The Agency's legal authority and promulgated methodology for establishing treatment standards and the petition process necessary for requesting a variance from the treatment standards are summarized in EPA's Methodology for Developing BDAT Treatment Standards (Reference 41).

The BDAT treatment standards for K048-K052 nonwastewaters that were promulgated on August 8, 1988 (known as the final rule for the "First Third") were developed based on data that were collected by EPA on incineration of these wastes, data that were submitted to the Agency on solvent extraction of the wastes, and data available to EPA on treatment of metals in the wastewater and nonwastewater residuals. However, some of the solvent extraction data submitted to the Agency were not received in time to allow them to be fully evaluated before the promulgation date. As a result, treatment standards for xylene and naphthalene in K048-K052 nonwastewaters were reserved. Since promulgation of K048-K052 treatment standards, the Agency has reviewed these data as well as additional new data submitted to the Agency following promulgation. The Agency has also recently conducted a test to collect data on solvent extraction treatment of K048 and K051.

Based on all data available at this time, the Agency is proposing revised treatment standards for 14 regulated organic constituents in

nonwastewater forms of K048-K052. The Agency is also proposing the addition of treatment standards for xylene and naphthalene (previously reserved) in nonwastewater forms of K048-K052. Finally, the Agency is proposing the addition of cyanide as a regulated constituent in wastewater forms of K048-K052, and is proposing a numerical treatment standard for cyanide. The proposed changes to the BDAT treatment standards for organic constituents in K048-K052 nonwastewaters and cyanide in K048-K052 wastewaters are presented in Tables 1-1 and 1-2, respectively. The treatment standards promulgated on August 8, 1988 for metal constituents in nonwastewater forms of K048-K052 and for organic and metal constituents in wastewater forms of K048-K052 are not being revised at this time.

EPA also is proposing that these revised standards, with five exceptions, take effect exactly one year following the Third Third Rulemaking promulgation date. This effective date is being proposed to allow the petroleum refining industry sufficient time to make necessary arrangements to comply with changes to the K048-K052 BDAT treatment standards. The five exceptions to the one year delayed effective date are benzo(a) pyrene, ortho and para cresols, di-n-butyl phthalate, and phenol. Treatment standards for these five constituents are proposed to be effective on August 8, 1990. Industry will not need extra time to comply since these standards are higher and therefore less stringent than those previously promulgated. Until the revised standards take effect for all other constituents, the previously promulgated standards, which due to the two year capacity variance issued for K048-K052 as

part of the First Third rule become effective on August 8, 1990, will remain in effect.

This amendment to the Final Best Demonstrated Available Technology (BDAT) Background Document for K048, K049, K050, K051, K052 (Reference 40)

(1) presents the K048 and K051 solvent extraction data used to develop the proposed treatment standards for nonwastewaters; (2) presents the K048 incinerator scrubber water data used to develop the proposed treatment standards for wastewaters; and (3) provides EPA's rationale and technical support for developing proposed revised treatment standards for regulated organic constituents and adding treatment standards for xylene and naphthalene in K048-K052 nonwastewaters and for selecting cyanide as a proposed regulated constituent in wastewater forms of K048-K052.

Sections 2.0 through 6.0 of this document amend sections in the Final BDAT Background Document for K048-K052 by presenting additional waste characterization data, treatment performance data, accuracy-corrected data, selection of cyanide as a proposed regulated constituent in K048-K052 wastewaters, and calculation of proposed treatment standards, respectively.

Section 7.0 contains acknowledgements, and Section 8.0 lists references. Appendix A lists petroleum refinery plant codes and Appendix B contains quality assurance/quality control data. Appendix C presents data from statistical tests comparing the recently obtained solvent extraction data to that used to develop the treatment standards promulgated on August 8, 1988 in the First Third Final rule. Appendix D presents detection limits for all

constituents analyzed in the untreated and treated wastes from the Agency-sponsored solvent extraction test and for cyanide in the untreated waste and incinerator scrubber water from the Agency-sponsored incineration test.

Specific changes to the BDAT treatment standards for organic constituents in K048-K052 nonwastewaters and for cyanide in K048-K052 wastewaters that are being proposed are discussed below.

Nonwastewaters

After the close of the comment period for the proposed regulations for First Third wastes, EPA received additional data on solvent extraction treatment of K048-K052. These data were received too late to allow a full evaluation and inclusion in the development of the promulgated BDAT treatment standards. Since promulgation of the land disposal restrictions for First Third wastes in August 1988, the Agency has reviewed these data as well as additional new data submitted following promulgation. The Agency has also recently completed a solvent extraction treatment test on a mixture of K048 and K051. For most of the regulated organic constituents in K048-K052 nonwastewaters, the solvent extraction data collected by the Agency show better or similar treatment than the data used to develop the previously promulgated standards. Overall, based on statistical comparative analyses (see Appendix C), the Agency believes that these data provide the most substantial treatment for the greatest number of organic constituents of concern than all of the other solvent extraction data available to the Agency. Therefore, the Agency

is proposing revised treatment standards for the organic constituents already regulated in K048-K052 nonwastewaters based on the results of the solvent extraction treatment test conducted by the Agency. The proposed treatment standards are presented in Table 1-1. The Agency has not reevaluated the selection of solvent extraction and incineration as BDAT for organic constituents in K048-K052 nonwastewaters but has instead incorporated the additional solvent extraction treatment performance data into the revision of these treatment standards. However, these wastes may be treated by any treatment technology capable of achieving the treatment standards.

The Agency also is proposing nonwastewater treatment standards for two constituents for which it reserved treatment standards in the First Third rule, naphthalene and xylene. The results from the recently completed Agency-sponsored solvent extraction test provide treatment performance data for solvent extraction of naphthalene and xylene as well as the other regulated organic constituents in K048-K052 nonwastewaters. There are important environmental reasons to develop treatment standards for xylene and naphthalene in these wastes. These solvents have been found to be present at high concentrations in these wastes (0.1 percent or higher), and at these levels can readily mobilize other land disposed constituents or degrade landfill liners resulting in increased mobilization. The Agency is also concerned about the potential contribution of these constituents to VOC emissions from land disposal facilities. Thus, treatment of these constituents will clearly serve to reduce the mobility of land disposed K048-K052 (and any wastes with which they are co-disposed) (see Section 3004(m)(1)).

EPA has recently received solvent extraction treatment performance data from Exxon Company, U.S.A., and the American Petroleum Institute (API). These data were not received by the Agency in time to be fully evaluated for this proposed rulemaking. The data are, however, available for review in the administrative record for this proposed rulemaking. These data will be fully evaluated by the Agency prior to promulgation of the Third Third rule and may be used by the Agency to provide further revisions to the K048-K052 BDAT treatment standards, if appropriate.

Wastewaters

For wastewater forms of K048-K052, the Agency is proposing to add cyanide as a regulated constituent and is proposing BDAT treatment standards for cyanide based on incineration of these wastes. At the time of proposal for the First Third wastes, the Agency did not have data on treatment of cyanide in wastewater forms of K048-K052 and did not have data on treatment of cyanide in other wastes that could be transferred to K048-K052 wastewaters. Data for cyanide in combustion gas scrubber water from incineration of K048 became available to the Agency too late in the regulatory schedule for the First Third final rule. These data have now been used to develop the proposed treatment standards for cyanide in K048-K052 wastewaters. The Agency expects treatment of cyanide to occur using incineration technologies. Solvent extraction, although considered a BDAT technology for all other organic constituents regulated in K048-K052 nonwastewaters, has not been demonstrated

to treat cyanide. The cyanide treatment standard for wastewater forms of K048-K052 is shown in Table 1-2 at the end of this section.

Table 1-1

PROPOSED BDAT TREATMENT STANDARDS FOR
ORGANIC CONSTITUENTS IN K048-K052
NONWASTEWATERS

(REVISED)

Maximum for any Single Grab Sample					
BDAT List Constituent	Total Concentration (mg/kg)				
	K048	K049	K050	K051	K052
4. Benzene	3.9	3.9	NA	3.9	3.9
43. Toluene	3.9	3.9	NA	3.9	3.9
215-					
217. Xylene (total)	8.5	8.5	NA	8.5	8.5
226. Ethylbenzene	0.08	0.08	NA	0.08	0.08
57. Anthracene	NA	1.4	NA	1.4	NA
59. Benz(a)anthracene	NA	NA	NA	1.4	NA
62. Benzo(a)pyrene	1.4	1.4	1.4	1.4	1.4
70. Bis(2-ethylhexyl)phthalate	4.3	4.3	NA	4.3	NA
80. Chrysene	0.84	0.84	NA	0.84	NA
81. o-Cresol	NA	NA	NA	NA	6.8
82. p-Cresol	NA	NA	NA	NA	6.8
98. Di-n-butyl phthalate	4.3	NA	NA	4.3	NA
121. Naphthalene	0.84	0.84	NA	0.84	0.84
141. Phenanthrene	0.84	0.84	NA	0.84	0.84
142. Phenol	4.3	4.3	4.3	4.3	4.3
145. Pyrene	1.1	1.1	NA	1.1	NA

NA - Not applicable.

Table 1-2

PROPOSED BDAT TREATMENT STANDARDS FOR
CYANIDE IN K048-K052
WASTEWATERS

(REVISED)

Maximum for any Single Grab Sample					
<u>BDAT List Constituent</u>	<u>Total Concentration (mg/l)</u>				
	<u>K048</u>	<u>K049</u>	<u>K050</u>	<u>K051</u>	<u>K052</u>
169. Cyanide	0.028	0.028	0.028	0.028	0.028

2.0 AMENDMENT TO SECTION 2.2 (WASTE CHARACTERIZATION) OF THE FINAL BDAT
BACKGROUND DOCUMENT FOR K048-K052

This section supplements Section 2.2 of the Final BDAT Background Document for K048-K052 by presenting additional waste characterization data for mixtures of K048 and K051. Specifically, Table 2-1 is amended to include data in columns (i) and (j) that were obtained from treatment tests conducted by the EPA subsequent to promulgation of the First Third Rule. These data represent 50:50 mixtures (by volume) of K048 and K051 from samples collected at Plant A and Plant Q. Plant codes are listed in Appendix A.

Table 2-1

AVAILABLE CHARACTERIZATION DATA FOR K048-K052 MIXTURES

BDAT LIST ORGANICS

Volatiles	(a)	(b)	(c)	Concentration of Untreated Waste (ppm)					(j)	Range*
				(d)	(e)	(f)	(g)	(h)		
222. Acetone	---	---	---	---	---	---	---	---	12-61	12-61
4. Benzene	86-190	---	2,100	530	9.8	600	80	60	8.5-18	8.5-2,100
226. Ethylbenzene	76-120	---	1,300	1,100	17	---	86	110	28-64	17-1,300
43. Toluene	230-470	---	6,300	1,500	68	6,600	340	360	64-150	40-6,600
45. 1,1,1-Trichloroethane	---	---	---	---	---	---	---	---	---	381
215-217. Xylenes (total)	420-570	---	5,900	4,000	106	8,880	430	690	130-240	104-8,880
Semivolatiles										
57. Anthracene	---	---	22	29	0.069	<46	13.3	9.4	3.4	0.069-29
59. Benz(a)anthracene	<20-21	---	17	18	0.14	---	3.4	20	6.2-6.8	0.14-22
62. Benzo(a)pyrene	<19-<21	---	9.4	11	0.071	---	1.8	9.9	2.3-3.5	0.071-11
63. Benzo(b) Fluoranthene	---	---	6.3	8	0.041	---	1.2	6.2	---	1.7
70. Bis(2-ethylhexyl)phthalate	<19-<21	<3-49	4.2	<2	<0.009	---	1.1	<1	---	1.1-49
80. Chrysene	<20-33	4.7-<7	19	30	0.24	---	9.4	26	9.4-12.2	0.24-42
81. o-Cresol	---	---	<2	<2	0.33	<19	0.4	<1	---	0.33-0.4
82. p-Cresol	---	---	<2	<2	0.42	---	1.3	<1	---	0.42-1.3
83. Dibenz(a,h)anthracene	---	---	3.9	<2	<0.009	---	1.1	<1	---	1.1-3.9
87. 1,2-Dichlorobenzene	<19-<21	<3-3.3	---	---	---	---	---	---	---	3.3
96. 2,4-Dimethylphenol	---	<3-<7	<10	<2	<0.009	---	0.7	<1	---	0.7
108. Fluoranthene	<19-<21	<3-3.7	9.2	10	0.55	---	<1	5.9	1.7-3.1	0.055-10
109. Fluorene	---	3.4-<7	---	---	---	---	---	---	11.6-18.9	3.4-18.9
121. Naphthalene	56-140	22-30	180	490	1.1	560	82	90	41.6-54	1.1-560
141. Phenanthrene	64-140	13-17	240	210	0.53	740	109	47	37.7-54.3	0.53-740
142. Phenol	---	<3-<7	<2	<2	1.7	<1,900	0.9	<1	2.1-9.4	0.9-9.4
145. Pyrene	<20-36	<3-3.6	59	95	0.25	---	26	22	11-13.7	0.25-95
52. Acenaphthene	---	---	---	---	---	---	---	---	2.2-5.5	2.2-5.5
64. Benzo(g,h,i)perylene	---	---	---	---	---	---	---	---	1.52	1.52

--- Data are not available for this constituent.

(a) K048-K052 mixture of refinery wastes: BP America, Inc. comments on land disposal restrictions, 1988 (Reference 36).

(b) Mixture of K049 and K051: Resources Conservation Company, comments on land disposal restrictions, 1988 (Reference 37).

(c) Unspecified mixture of refinery wastes: Plant C, API, comments on land disposal restrictions, 1987 (Reference 26).

(d) Mixture of K048, K049, and K051: Plant D, API, comments on land disposal restrictions, 1987 (Reference 26).

(e) Mixture of K051 and K052: Plant E, API, comments on land disposal restrictions, 1987 (Reference 26).

(f) Mixture of K049 and K051: Plant F, API, comments on land disposal restrictions, 1987 (Reference 26).

(g) Unspecified mixture of refinery wastes: Plant H, API, comments on land disposal restrictions, 1987 (Reference 26).

(h) Mixture of K051 and K052: Plant H, API, comments on land disposal restrictions, 1987 (Reference 26).

(i) Mixture of K048 and K051: Characterization Report for K048 and K051, Amoco Oil Company, Whiting, IN (Reference 42).

(j) Mixture of K048 and K051: Plant Q, Onsite Engineering Report of Treatment Technology Performance and Operation for CF Systems, Waltham, MA, (Reference 43).

* Values less than detection limits are not included in the range of concentrations.

† Due to chromatographic coelution, p-Cresol and m-Cresol have been reported as total m- and p-Cresol. This result is not included in the ranges of concentrations.

Table 2-1 (Continued)

AVAILABLE CHARACTERIZATION DATA FOR K048-K052 MIXTURES

BDAT List Metals	Concentration of Untreated Waste (ppm)										Range*
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	
154. Antimony	---	---	---	---	---	---	---	---	8.7	5.8	5.8-8.7
155. Arsenic	---	---	<0.2	1.2	0.8	---	2.0	7.0	1.5	3.6-4.0	0.8-7
156. Barium	---	---	120	21	54	---	115	142	63	16-70	0.13-142
158. Cadmium	---	0.13-0.62	<0.5	<0.5	<0.5	---	<2	1	1	0.55-0.73	0.55-1
159. Chromium (total)	---	0.07-0.09	150	150	328	220	340	835	119	24-225	0.07-835
160. Copper	---	---	30	---	---	---	---	---	73	14-108	14-108
161. Lead	---	4.2-5.1	30	8.2	48	27	40	126	183	30-160	4.2-160
162. Mercury	---	<0.001	0.09	<0.05	0.13	---	0.2	2.9	3.1	0.38-2.6	0.09-3.1
163. Nickel	---	---	7	---	---	---	---	---	36	6.8-19	6.8-36
164. Selenium	---	---	---	---	---	---	---	---	1.2	0.75-5.3	0.75-5.3
167. Vanadium	---	---	2.7	---	---	---	---	---	118	26-147	2.7-147
168. Zinc	---	11-16	---	---	---	---	---	---	295	69-294	11-295
Inorganics											
169. Cyanide	---	---	---	---	---	---	---	---	0.60	---	0.60
170. Sulfide	---	---	---	---	---	---	---	---	464	102	102-464
171. Fluoride	---	---	---	---	---	---	---	---	0.47	---	0.47
BDAT List Organics PCBs											
203. Aroclor 1242	---	1.3-8.7	---	---	---	---	---	---	---	---	1.3-8.7
206. Aroclor 1260	---	0.55-3.5	---	---	---	---	---	---	---	---	0.55-3.5
Dioxins/Furans											
212. Tetrachlorodibenzofuran	---	---	---	---	---	---	---	---	---	0.0013	0.0013

--- Data are not available for this constituent.

(a) K048-K052 mixture of refinery wastes: BP America, Inc. comments on land disposal restrictions, 1988 (Reference 36).

(b) Mixture of K049 and K051: Resources Conservation Company, comments on land disposal restrictions, 1988 (Reference 37).

(c) Unspecified mixture of refinery wastes: Plant C, API, comments on land disposal restriction, 1987 (Reference 26).

(d) Mixture of K048, K049, and K051: Plant D, API, comments on land disposal restrictions, 1987 (Reference 26).

(e) Mixture of K051 and K052: Plant E, API, comments on land disposal restrictions, 1987 (Reference 26).

(f) Mixture of K049 and K051: Plant F, API, comments on land disposal restrictions, 1987 (Reference 26).

(g) Unspecified mixture of refinery wastes: Plant H, API, comments on land disposal restrictions, 1987 (Reference 26).

(h) Mixture of K051 and K052: Plant H, API, comments on land disposal restrictions, 1987 (Reference 26).

(i) Mixture of K048 and K051: Characterization Report for K048 and K051, Amoco Oil Company, Whiting, IN (Reference 42).

(j) Mixture of K048 and K051: Plant Q, Onsite Engineering Report of Treatment Technology Performance and Operation for CF Systems, Waltham, MA. (Reference 43).

* Values less than detection limits are not included in the range of concentrations.

AVAILABLE CHARACTERIZATION DATA FOR K048-K052 MIXTURES

----- Data are not available for this constituent.

(a) K048-K052 mixture of refinery wastes: BP America, Inc. comments on land disposal restrictions, 1988 (Reference 36).

(b) Mixture of K049 and K051: Resources Conservation Company, comments on land disposal restrictions, 1988 (Reference 37).

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(d) Mixture of K048, K049, and K051: Plant C, API, comments on land disposal restrictions, 1987 (Reference 26).

(e) Mixture of K048, K049, and K051: Plant D, API, comments on land disposal restrictions, 1987 (Reference 26).

(f) Mixture of K048, K049, and K051: Plant E, API, comments on land disposal restrictions, 1987 (Reference 26).

(g) Mixture of K048, K049, and K051: Plant F, API, comments on land disposal restrictions, 1987 (Reference 26).

(h) Mixture of K048, K049, and K051: Plant H, API, comments on land disposal restrictions, 1987 (Reference 26).

(i) Mixture of K048 and K051: Plant G, API, comments on land disposal restrictions, 1987 (Reference 26).

(j) Mixture of K048 and K051: Unspecified mixture of refinery wastes: Plant H, API, comments on land disposal restrictions, 1987 (Reference 26).

(k) Mixture of K048 and K051: Unspecified mixture of refinery wastes: Plant H, API, comments on land disposal restrictions, 1987 (Reference 26).

(l) Mixture of K048 and K051: Characterization Report for K048 and K051, Amoco Oil Company, Whiting, IN (Reference 42).

(m) Mixture of K048 and K051: Onsite Engineering Report of Treatment Technology Performance and Operation for CF Systems, Waltham, MA, (Reference 43).

3.0 AMENDMENT TO SECTION 4.0 (PERFORMANCE DATA BASE) OF THE FINAL BDAT
BACKGROUND DOCUMENT FOR K048-K052

This section supplements Section 4.0 of the Final BDAT Background Document for K048-K052. This section presents treatment performance data that were considered by EPA in developing the proposed revise treatment standards for organic constituents in K048-K052 nonwastewaters and the proposed treatment standards for cyanide in K048-K052 wastewaters. For organics in K048-K052 nonwastewaters, the Agency analyzed solvent extraction data from three sources. For cyanide in K048-K052 wastewaters, the Agency analyzed incineration data from one source. These data sources are discussed in greater detail in the following subsections.

The Agency also received treatment performance data for K048-K052 from Exxon Company, U.S.A. (Reference 44) and the American Petroleum Institute (Reference 45). These data were received by EPA too late to be evaluated for this proposed rulemaking. However, these data are included in the administrative record for this proposed rulemaking and will be fully evaluated by the Agency prior to promulgation of the Third Third final rule.

3.1 Solvent Extraction Performance Data Base

The Agency conducted a test of a solvent extraction process at Plant Q for treatment of a 50:50 mixture (by volume) of K048 and K051. The solvent extraction process tested was the CF Systems process which uses liquified

propane as the solvent. The solvent extraction treatment performed at Plant Q was followed by centrifugation of the raffinate (treated waste) to remove free liquid present in the raffinate. The resulting nonwastewater treatment residual is referred to as the raffinate solids. The Agency collected four sample sets of raffinate solids from this treatment test. Table 3-1 presents the treatment performance data for this K048 and K051 waste mixture. Data are presented for the regulated organic constituents detected in the untreated waste mixture and/or the treated raffinate solids. Detection limits for these samples are included in Appendix D. Design and operating parameters for the solvent extraction unit and for the centrifuge used to separate the solid and liquid fractions of the solvent extraction raffinate are shown in Table 3-2.

Solvent extraction data from Plant O were submitted by CF systems and are included in Appendix F.9 of the Final BDAT Background Document for K048-K052. CF Systems also submitted solvent extraction data from Plant T. These data are confidential and are included in the confidential rulemaking record (Reference 46). Neither of these data sources were further considered in developing treatment standards for organics in K048-K052 nonwastewaters since these data show that a majority of the constituents of concern were not detected in the untreated waste. Furthermore, the samples analyzed from Plant T represent treatment of full-scale solvent extraction followed by bench-scale filtration. Since data are available for full-scale solvent extraction followed by full-scale centrifugation from Plant Q, the Agency prefers to use the full-scale data rather than the bench-scale data, consistent with the BDAT methodology.

3.2 Incineration Performance Data Base

For cyanide in K048-K052 wastewaters, the Agency analyzed performance data from the EPA-conducted test of fluidized bed incineration of K048 at Plant A. The data shown in Table 3-3 are for cyanide in six sample sets of untreated K048 and fluidized bed incinerator combustion gas scrubber water samples. Design and operating parameters for the fluidized bed incinerator are shown in Table 3-4.

Table 3-1

PERFORMANCE DATA COLLECTED BY EPA FOR TREATMENT OF K048 AND K051 AT
PLANT Q -SOLVENT EXTRACTION FOLLOWED BY CENTRIFUGATION

BDAT List Constituent	UNTREATED WASTE		TREATED WASTE	
	Detection Limit (mg/kg)	Concentration of K048 and K051 Mixture (mg/kg)	Detection Limit (mg/kg)	Raffinate Solids Concentration (mg/kg)
VOLATILE ORGANICS				
4. Benzene	2.5	8.5	0.05	0.22
	5	12	0.05	0.09
	5	18	0.05	0.13
	3.1	9.2	0.05	0.1
43. Toluene	2.5	73	0.05	0.94
	5	67	0.05	0.37
	5	150	0.05	0.45
	3.1	64	0.05	0.27
215 - 217. Xylene (total)	2.5	150	0.05	0.19
	5	150	0.05	0.09
	5	240	0.05	0.09
	3.1	130	0.05	0.09
226. Ethylbenzene	2.5	37	0.05	0.06
	5	30	0.05	<0.05
	5	64	0.05	<0.05
	3.1	28	0.05	<0.05
SEMIVOLATILE ORGANICS				
57. Anthracene	1.36	<1.36	0.33	<0.33
	1.28	<1.28	0.33	<0.33
	2.72	3.4	0.33	<0.33
	1.36	4.36	0.33	<0.33

Table 3-1 (Continued)

PERFORMANCE DATA COLLECTED BY EPA FOR TREATMENT OF K048 AND K051 AT
PLANT Q -SOLVENT EXTRACTION FOLLOWED BY CENTRIFUGATION

BDAT List Constituent	UNTREATED WASTE		TREATED WASTE	
	Detection Limit (mg/kg)	Concentration of K048 and K051 Mixture (mg/kg)	Detection Limit (mg/kg)	Raffinate Solids Concentration (mg/kg)
SEMIVOLATILE ORGANICS (Continued)				
59. Benz(a)anthracene	1.36	<1.36	0.33	<0.33
	1.28	6.2	0.33	<0.33
	2.72	6.8	0.33	<0.33
	1.36	6.7	0.33	<0.33
62. Benzo(a)pyrene	1.36	3.5	0.33	<0.33
	1.28	2.3	0.33	<0.33
	2.72	<2.72	0.33	<0.33
	1.36	2.4	0.33	<0.33
70. Bis(2-ethylhexyl)phthalate	1.36	<1.36	0.33	<0.33
	1.28	<1.28	0.33	<0.33
	2.72	<2.72	0.33	<0.33
	1.36	<1.36	0.33	<0.33
80. Chrysene	1.36	11.6	0.33	0.42
	1.28	12.2	0.33	<0.33
	2.72	11.9	0.33	<0.33
	1.36	9.4	0.33	<0.33
81. o-Cresol	1.36	<1.36	0.33	<0.33
	1.28	<1.28	0.33	<0.33
	2.72	<2.72	0.33	<0.33
	1.36	<1.36	0.33	<0.33
82. p-Cresol	1.36	7	0.33	2.6
	1.28	3.9	0.33	1.9
	2.72	3	0.33	2.3
	1.36	7.9	0.33	1.1

Table 3-1 (Continued)

PERFORMANCE DATA COLLECTED BY EPA FOR TREATMENT OF K048 AND K051 AT
PLANT Q - SOLVENT EXTRACTION FOLLOWED BY CENTRIFUGATION

BDAT List Constituent	UNTREATED WASTE		TREATED WASTE	
	Detection Limit (mg/kg)	Concentration of K048 and K051 Mixture (mg/kg)	Detection Limit (mg/kg)	Raffinate Solids Concentration (mg/kg)
SEMIVOLATILE ORGANICS (Continued)				
98. Di-n-butyl phthalate	1.36	<1.36	0.33	<0.33
	1.28	<1.28	0.33	<0.33
	2.72	<2.72	0.33	<0.33
	1.36	<1.36	0.33	<0.33
121. Naphthalene	1.36	54	0.33	0.38
	1.28	44	0.33	<0.33
	2.72	41.6	0.33	<0.33
	1.36	51.5	0.33	<0.33
141. Phenanthrene	1.36	42.4	0.33	0.46
	1.28	43.8	0.33	0.4
	2.72	54.3	0.33	<0.33
	1.36	37.7	0.33	0.35
142. Phenol	1.36	5.2	0.33	1.1
	1.28	2.1	0.33	1.2
	2.72	<2.72	0.33	1.8
	1.36	9.4	0.33	0.74
145. Pyrene	1.36	13	0.33	0.67
	1.28	12.3	0.33	<0.33
	2.72	13.7	0.33	<0.33
	1.36	11	0.33	0.48

Source: CF Systems Onsite Engineering Report (Reference 43).

Table 3-2

OPERATING PARAMETERS FOR THE SOLVENT EXTRACTION
UNIT AND CENTRIFUGE AT PLANT Q

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SOLVENT EXTRACTION UNIT

Physical Design Parameters	Values or Description
Number of Stages per Pass	2
Number of Passes	5
Total Number of Stages	10
Extractor 1:	
Pressure (psig)	235-270
Temperature (deg F)	68-90
Extractor 2:	
Pressure (psig)	210-255
Temperature (deg F)	72-94
Mixer Speeds (rpm)	1200

CENTRIFUGE

Physical Design Parameters	Values or Description
Manufacturer	Sharples Model P660 Super-D-Canter Centrifuge
Power Supply	460V, 3 Phase, 60 Cycle Can be adjusted to 220V
Maximum variable speed back drive (rpm)	6000
Bowl Speed (rpm)	4930
Conveyor Speed (rpm)	2756
Belt Tension	9.5

Source: CF Systems Onsite Engineering Report (Reference 43).

Table 3-3

PERFORMANCE DATA COLLECTED BY EPA FOR TREATMENT OF K048 AT
PLANT A - FLUIDIZED BED INCINERATOR COMBUSTION GAS SCRUBBER WATER

BDAT List Constituent	UNTREATED WASTE		TREATED WASTE	
	Detection Limit (mg/l)	K048 Concentration (mg/l)	Detection Limit (mg/l)	Combustion Gas Scrubber Water Concentration (mg/l)
169. Cyanide	0.6	<0.06	0.01	<0.01
	0.6	7.9	0.01	<0.01
	0.6	2.6	0.01	<0.01
	0.6	1.1	0.01	<0.01
	0.6	<0.06	0.01	<0.01
	0.6	4.5	0.01	<0.01

Source: Amoco Oil Company Onsite Engineering Report (Reference 47).

Table 3-4

DESIGN AND OPERATING PARAMETERS FOR THE
FLUIDIZED BED INCINERATOR AT PLANT A

<u>Physical Design Parameters</u>	<u>Value or Description</u>
Incinerator manufacturer	Dorr-Oliver (Fluosolids) ^R
Incinerator height	40 ft
Incinerator diameter:	
Base of incinerator	22 ft (OD), 20 ft (ID)
Top of incinerator	30 ft (OD), 28 ft (ID)
Wall thickness	1 ft of refractory
Materials of construction:	
Reactor	Carbon steel wall with 12 inch refractory lining
Refractory	Refractory materials are cast blocks and laid bricks anchored with 304 stainless steel
Constriction plate	Refractory
Ducts	Refractory-lined carbon steel
Cyclones	Refractory-lined carbon steel
Venturi scrubber	304 ELC stainless steel
Stack	304 ELC stainless steel
Thickener tank	A36 steel
Bed material	Quartz white silica sand (#16 or #10 filter sand)
Stack diameter	5 ft
Stack height	80 ft (approximately)
Thickener tank capacity	80,070 gallons
Thickener tank dimensions:	
Diameter	40 feet
Centerwell height	approximately 8 feet and 6 inches

Table 3-4 (Continued)

DESIGN AND OPERATING PARAMETERS FOR THE
FLUIDIZED BED INCINERATOR AT PLANT A

<u>Physical Design Parameters</u>	<u>Value or Description</u> ¹
Bed Temperature	1200 - 1300°F (1400°F Max.)
Freeboard Temperature	1250 - 1350°F (1450°F Max.)
Undewatered DAF Float Mixture Feed Rate	30 - 90 gpm
Constriction Plate Pressure Differential	15 - 20 in. H ₂ O
Fluidized Bed Pressure Differential	60 - 100 in. H ₂ O
Stack Gas Carbon Monoxide Concentration	35 - 800 ppm CO

¹Ranges shown are nominal operating ranges as provided by plant personnel.

Source: Amoco Oil Company Onsite Engineering Report (Reference 47).

4.0 AMENDMENT TO SECTION 5.0 (IDENTIFICATION OF BEST DEMONSTRATED AND AVAILABLE TECHNOLOGY) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K048-K052

This section amends Section 5.0 of the Final BDAT Background Document for K048-K052 as delineated below:

<u>Section</u>	<u>Amended Section</u>	<u>Amendment</u>
4.1	5.1	Preliminary data review of the solvent extraction and incineration data presented in Section 3.0 of this document.
4.2	5.2.1	Accuracy correction of the solvent extraction data presented in Section 3.0 of this document.
4.3	5.2.2	Accuracy correction of the incineration data presented in Section 3.0 of this document.
4.4	5.3	Comparison of solvent extraction treatment performance at Plants Q and M.
4.5	5.7	Identification of BDAT for cyanide in wastewaters.

4.1 Amendment to Section 5.1 - Preliminary Data Review

Treatment performance data for solvent extraction treatment of K048 and K051 at Plant Q and fluidized bed incineration of K048 at Plant A are presented in Section 3.0 of this document. These treatment performance data were reviewed and assessed to determine whether they represent operation of well-designed and well-operated treatment systems and whether sufficient quality assurance/quality control (QA/QC) measures were employed to ensure the

accuracy of the data. Following the data review, the Agency had no reason to believe that either of the treatment systems were not well-designed or well-operated or that there were any insufficiencies in the QA/QC measures that were employed to ensure the accuracy of the data.

4.2 Amendment to Section 5.2.1 - Accuracy Correction of Treatment
Performance Data for Nonwastewaters

Presented below is a description of how treatment performance data for solvent extraction treatment at Pant Q of organic constituents in nonwastewaters were adjusted for each regulated BDAT List constituent that was detected in the untreated waste.

Matrix spike and duplicate matrix spike recoveries that were used to adjust the treatment performance data for the raffinate solids from solvent extraction treatment of K048 and K051 are presented in Table B-5 of Appendix B of this document. The matrix spike recovery used to adjust treatment performance data for each constituent was the lower of the two values from the matrix spike and the duplicate spike. For constituents for which no matrix spike was performed, the matrix spike recovery used to adjust the treatment performance data was the average matrix spike recovery of the appropriate group of constituents (volatile or semivolatile).

Accuracy correction factors that were calculated for the raffinate solids data are presented in Table B-11 of Appendix B of this document. (The

accuracy correction factor is equal to 100 divided by the percent recovery.) Treatment performance data for each regulated BDAT List organic constituent detected in the untreated waste were corrected for accuracy and are presented in Table 4-1. Accuracy correction factors less than 1.0 (i.e., factors that would result in a reduction in constituent concentration) were not used to correct treatment performance data. A correction factor of 1.0 was used in these cases.

4.3 Amendment to Section 5.2.2 - Accuracy Correction of Treatment Performance Data for Wastewaters

Presented below is a description of how treatment performance data for cyanide in scrubber water were adjusted for accuracy.

The matrix spike recovery and duplicate matrix spike recovery for cyanide in combustion gas scrubber water at Plant A were 102% and 104%, respectively. Since both values are greater than 100%, an accuracy correction factor of 1.0 was used for cyanide. The corrected treatment concentrations for cyanide in the combustion gas scrubber water from fluidized bed incineration are presented in Table 4-2.

4.4 Amendment to Section 5.3 - Identification of BDAT for Organic
Constituents in K048-K052 Nonwastewaters

The Agency compared the performance of solvent extraction at Plant Q (the recently obtained data) to the performance of three-cycle solvent extraction at Plant M, (the technology used to develop data for the First Third promulgated standards). Treatment performance data for these technologies were compared using the Wilcoxon rank-sum test as described in Appendix C of this document. This comparison was performed in order to determine whether one technology performed significantly better than the other for treatment of BDAT List organic constituents in nonwastewaters. The results of the statistical comparison are presented in Appendix C. The statistical comparison showed that solvent extraction at Plant Q provided significantly better treatment than three-cycle solvent extraction at Plant M for most of the semivolatile and all of the volatile regulated constituents.

As was determined in the Final BDAT Background Document for K048-K052, solvent extraction and incineration are BDAT for K048-K052 nonwastewaters.

4.5 Amendment to Section 5.7 - Identification of BDAT for Cyanide in
K048-K052 Wastewaters

Scrubber water is generated as a treatment residual from incineration in systems using wet scrubber air pollution control devices. The Agency

has treatment performance data for cyanide in the combustion gas scrubber water residual from fluidized bed incineration treatment of K048. The Agency has no data from other technologies for treatment of cyanide in K048-K052 wastewaters. For this reason, EPA has determined that fluidized bed incineration provides the "best" treatment for cyanide in K048 wastewaters. This technology is also "available" since it is commercially available and it provides substantial treatment of the cyanide in wastewaters. The BDAT treatment standard for cyanide in K048 wastewaters is therefore based on the performance achieved in the combustion gas scrubber water from fluidized bed incineration.

As discussed in Section 2.0 of the Final BDAT Background Document for K048-K052, EPA has determined that refinery wastes K048-K052 represent a waste treatability group. Therefore, since fluidized bed incineration is the technology basis for the BDAT treatment standard for cyanide in wastewater forms of K048, this technology also provides the technology basis for the BDAT treatment standard for cyanide in wastewater forms of K049, K050, K051, and K052.

Table 4-1

CORRECTED CONCENTRATION DATA FOR ORGANIC CONSTITUENTS
IN K048 AND K051 RAFFINATE SOLIDS

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Corrected Concentration in the Raffinate Solids

BDAT List Constituent*	Sample Set #1 (mg/kg)	Sample Set #2 (mg/kg)	Sample Set #3 (mg/kg)	Sample Set #4 (mg/kg)
VOLATILE ORGANICS				
4. Benzene	0.41	0.16	0.24	0.18
43. Toluene	0.94	0.37	0.45	0.27
215-				
217. Xylene (total)	0.26	0.13	0.12	0.12
226. Ethylbenzene	0.07	<0.06	<0.06	<0.06
SEMIVOLATILE ORGANICS				
57. Anthracene	<0.49	<0.49	<0.49	<0.49
59. Benz(a)anthracene	<0.49	<0.49	<0.49	<0.49
62. Benzo(a)pyrene	<0.49	<0.49	<0.49	<0.49
80. Chrysene	0.63	<0.49	<0.49	<0.49
82. p-Cresol	3.56	2.6	3.15	1.51
141. Phenanthrene	0.69	0.6	<0.49	0.54
142. Phenol	1.75	1.9	2.86	1.17
145. Pyrene	0.77	<0.38	<0.38	0.55

* Only regulated constituents detected in the untreated waste are presented in this table.

Table 4-2

CORRECTED CONCENTRATION DATA FOR CYANIDE IN K048
COMBUSTION GAS SCRUBBER WATER

Corrected Concentration in the Combustion Gas Scrubber Water (mg/l)						
BDAT List Constituent	Sample Set #1	Sample Set #2	Sample Set #3	Sample Set #4	Sample Set #5	Sample Set #6
169. Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

5.0 AMENDMENT TO SECTION 6.2.2 (SELECTION OF REGULATED CONSTITUENTS IN WASTEWATER) OF THE FINAL BDAT BACKGROUND DOCUMENT FOR K048-K052

This section amends Section 6.2.2 of the Final BDAT Background Document for K048-K052 to include cyanide as a regulated constituent in wastewater forms of K048-K052. Available characterization data for cyanide in untreated K048-K052 are summarized in Tables 2-4 through 2-8 of the Final BDAT Background Document for K048-K052. These data indicate that cyanide is present at treatable concentrations in all five refinery waste streams. Cyanide was not considered for regulation in K048-K052 wastewaters in the First Third rule because BDAT treatment performance data were not available soon enough to allow the Agency to fully evaluate the data. The Agency has completed its analysis of the treatment performance data for cyanide presented in Table 3-3 of this document and determined that the data represent significant treatment of cyanide. Therefore, cyanide is being selected for proposed regulation in wastewater forms of K048, K049, K050, K051, and K052.

6.0 AMENDMENT TO SECTION 7.0 (CALCULATION OF TREATMENT STANDARDS) OF THE
 FINAL BDAT BACKGROUND DOCUMENT FOR K048-K052

This section amends Sections 7.1 and 7.2 of the Final BDAT Background Document for K048-K052 by presenting a discussion of the calculation of proposed revised treatment standards for organic constituents in K048-K052 nonwastewaters and proposed treatment standard for cyanide in K048-K052 wastewaters.

6.1 Amendment to Section 7.1 - Calculation of Treatment Standards for
 Organic Constituents in Nonwastewater Forms of K048-K052

The best measure of performance for waste reduction or destruction technologies, such as solvent extraction and incineration, is the total amount of constituent remaining in the treatment residual after treatment. Therefore, BDAT treatment standards for nonwastewater organic constituents were calculated based on total constituent concentration data. The treatment standards being proposed for organic constituents in K048-K052 nonwastewaters were calculated based on four sample sets of treatment performance data for solvent extraction followed by centrifugation of K048 and K051 and six sample sets of treatment performed data for fluidized bed incineration of K048 and K051. The treatment standards were then transferred to K049, K050, and K052. Table 4-1 of this document presents the accuracy-corrected total concentration values for organic constituents in the raffinate solids for solvent extraction at Plant Q. Table 5-1 of the final BDAT Background Document for K048-K052

presents the accuracy-corrected total concentration values for incinerator ash at Plant A. Values are presented for all regulated organic constituents detected in the untreated or treated waste.

Tables 6-1 through 6-5 at the end of this section summarize the calculation of treatment standards for organic constituents in K048, K049, K050, K051, and K052 nonwastewaters, respectively. In order to ensure that both BDAT technologies, solvent extraction and incineration, can achieve the BDAT treatment standards, the Agency is proposing treatment standards for organic constituents in K048-K052 nonwastewaters based on the higher treatment standard (i.e., less stringent) calculated for solvent extraction or incineration for each regulated constituent. Solvent extraction data were used to develop treatment standards for all of the regulated organic constituents with the exceptions of the treatment standards for benzene, toluene, xylene, chrysene, naphthalene, and phenanthrene which were developed based on incineration data.

Three organic constituents, o-cresol, di-n-butyl phthalate, and bis(2-ethylhexyl)phthalate, in K048-K052 nonwastewaters were not detected in the untreated waste tested at Plant Q (solvent extraction). In addition, benzene was not detected in the untreated waste tested at Plant A (incineration). Data for calculation of treatment standards for these constituents were transferred from other regulated organic constituents that were detected in the untreated waste as discussed below.

4. Benzene. The treatment standards for benzene (boiling point 80°C) is based on data transferred from incineration of toluene (boiling point 111°C). Based on the discussion of waste characteristics affecting treatment performance of fluidized bed incineration in Section 3.4 of the Final BDAT Background Document for K048-K052, the Agency expects that benzene can be treated to concentrations as low or lower than toluene.

81. ortho-Cresol. The treatment standard for ortho-cresol is based on data transferred from solvent extraction treatment of para-cresol. Ortho-cresol is a structural isomer of para-cresol. Based on this structural similarity, the Agency expects that ortho-cresol can be treated by solvent extraction to concentrations similar to para-cresol.

70. Bis(2-ethylhexyl)phthalate and 98. Di-n-butyl phthalate. The treatment standards for bis(2-ethylhexyl)phthalate and di-n-butyl phthalate are based on data transferred from solvent extraction treatment of phenol. Phthalates are structurally related to phenol in that they can be synthesized from phenol. Phenol is difficult to treat by the type of solvent extraction process used at Plant Q because the solvent used was propane. Phenol is relatively insoluble in propane. Bis(2-ethylhexyl)phthalate and di-n-butyl phthalate are also expected to be relatively insoluble in propane based on structural similarities. Therefore, the Agency expects that bis(2-ethylhexyl)-phthalate and di-n-butyl phthalate can be treated to concentrations similar to phenol.

Amendment to Section 7.2 - Calculation of Treatment Standards for
Cyanide in Wastewater Forms of K048-K052

Incineration generally results in the generation of two treatment residuals: ash (a nonwastewater form) and combustion gas scrubber water (a wastewater form). The best measure of performance for a destruction technology, such as incineration, is the total amount of constituent remaining after treatment. Therefore, the BDAT treatment standards for cyanide in wastewaters were calculated based on total constituent concentration in the combustion gas scrubber water.

The proposed BDAT treatment standards for cyanide in K048-K052 wastewaters were calculated based on six sample sets of treatment performance data for combustion gas scrubber water from fluidized bed incineration of K048. These treatment performance data were then transferred to K049, K050, K051, and K052. Table 2-2 of this document presents the accuracy-corrected total concentration values for cyanide in the untreated and treated wastes for fluidized bed incineration at Plant A.

Table 6-6 at the end of this section summarizes the calculation of the treatment standards for cyanide in K048-K052 wastewaters.

TABLE 6-1
CALCULATION OF NONWASTEWATER TREATMENT STANDARDS FOR
ORGANIC CONSTITUENTS IN K048

Regulated Constituent	Constituent from which Data Were Transferred*	Untreated Concentration** (ppm)	Technology Basis	Arithmetic Average of Corrected Treatment Values (ppm)	Variability Factor(VF)	Treatment Standard+ (Average X VF) (ppm)
Volatiles						
4. Benzene	Toluene	22-120	Incineration	2.7	1.5	3.9
226. Ethylbenzene	NA	28 - 64	Solvent Extraction	0.06	1.2	0.08
43. Toluene	NA	22-120	Incineration	2.7	1.5	3.9
215.-217. Xylenes	NA	<14-120	Incineration	3.4	2.5	8.5
Semivolatiles						
62. Benzo(a)pyrene	NA	<2.72 - 3.5	Solvent Extraction	0.49	2.8	1.4
70. Bis (2-ethylhexyl) phthalate	Phenol	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3
80. Chrysene	NA	<20-51	Incineration	0.3	2.8	0.84
98. Di-n-butyl phthalate	Phenol	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3
121. Naphthalene	NA	93-170	Incineration	0.3	2.8	0.84
141. Phenanthrene	NA	77-120	Incineration	0.3	2.8	0.84
142. Phenol	NA	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3
145. Pyrene	NA	11 - 13.7	Solvent Extraction	0.52	2.1	1.1

* Data were transferred from K048 and K051.

** This is the concentration of each constituent in untreated K048 and K051 from which treatment performance data were transferred.

+ The values shown on this table for treatment standards have been rounded to show significant figures only.

NA Not applicable since treatment performance data were not transferred to this constituent.

TABLE 6-2
CALCULATION OF NONWASTEWATER TREATMENT STANDARDS FOR
ORGANIC CONSTITUENTS IN K049

Regulated Constituent	Constituent from Which Data Were Transferred*	Untreated Concentration** (ppm)	Technology basis	Arithmetic Average of Corrected Treatment Values (ppm)	Variability Factor(VF)	Treatment Standards (Average X VF) (ppm)
Volatiles						
4. Benzene	Toluene	22-120	Incineration	2.7	1.5	3.9
226. Ethylbenzene	Ethylbenzene	28 - 64	Solvent Extraction	0.06	1.2	0.08
43. Toluene	Toluene	22-120	Incineration	2.7	1.5	3.9
215.-217. Xylenes	Xylenes	<14-120	Incineration	3.4	2.5	8.5
Semivolatiles						
57. Anthracene	Anthracene	<1.28 - 4.36	Solvent Extraction	0.49	2.8	1.4
62. Benzo(a)pyrene	Benzo(a)pyrene	<2.72 - 3.5	Solvent Extraction	0.49	2.8	1.4
70. Bis (2-ethylhexyl) phthalate	Phenol	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3
80. Chrysene	Chrysene	<20-51	Incineration	0.3	2.8	0.84
121. Naphthalene	Naphthalene	93-170	Incineration	0.3	2.8	0.84
141. Phenanthrene	Phenanthrene	77-120	Incineration	0.3	2.8	0.84
142. Phenol	Phenol	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3
145. Pyrene	Pyrene	11 - 13.7	Solvent Extraction	0.52	2.1	1.1

* Data were transferred from K048 and K051.

** This is the concentration of each constituent in untreated K048 and K051 from which treatment performance data were transferred.

+ The values shown on this table for treatment standards have been rounded to show significant figures only.

TABLE 6-3
CALCULATION OF NONWASTEWATER TREATMENT STANDARDS FOR
ORGANIC CONSTITUENTS IN K050

Regulated Constituent	Constituent from Which Data Were Transferred*	Untreated Concentration** (ppm)	Technology Basis	Arithmetic Average of Corrected Treatment Values (ppm)	Variability Factor(VF)	Treatment Standard+ (Average X VF) (ppm)
Semivolatiles						
62. Benzo(a)pyrene	Benzo(a)pyrene Phenol	<2.72 - 3.5	Solvent Extraction	0.49	2.8	1.4
142. Phenol		2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3

* Data were transferred from K048 and K051.

** This is the concentration of each constituent in untreated K048 and K051 from which treatment performance data were transferred.

+ The values shown on this table for treatment standards have been rounded to show significant figures only.

TABLE 6-4
CALCULATION OF NONWASTEWATER TREATMENT STANDARDS FOR
ORGANIC CONSTITUENTS IN K051

Regulated Constituent	Constituent from Which Data Were Transferred*	Untreated Concentration** (ppm)	Technology Basis	Arithmetic Average of Corrected Treatment Values (ppm)	Variability Factor(VF)	Treatment Standard+ (Average X VF) (ppm)
Volatiles						
4. Benzene	Toluene	22-120	Incineration	2.7	1.5	3.9
226. Ethylbenzene	NA	28 - 64	Solvent Extraction	0.06	1.2	0.08
43. Toluene	NA	22-120	Incineration	2.7	1.5	3.9
215.-217. Xylenes	NA	<14-120	Incineration	3.4	2.5	8.5
Semivolatiles						
57. Anthracene	NA	<1.28 - 4.36	Solvent Extraction	0.49	2.8	1.4
59. Benzo(a)anthracene	NA	<1.36 - 6.8	Solvent Extraction	0.49	2.8	1.4
62. Benzo(a)pyrene	NA	<2.72 - 3.5	Solvent Extraction	0.49	2.8	1.4
70. Bis(2-ethylhexyl) phthalate	Phenol	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3
80. Chrysene	NA	<20-51	Incineration	0.3	2.8	0.84
98. Di-n-butyl phthalate	Phenol	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3
121. Naphthalene	NA	93-170	Incineration	0.3	2.8	0.84
141. Phenanthrene	NA	77-120	Incineration	0.3	2.8	0.84
142. Phenol	NA	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3
145. Pyrene	NA	11 - 13.7	Solvent Extraction	0.52	2.1	1.1

* Data were transferred from K048 and K051.

** This is the concentration of each constituent in untreated K048 and K051 from which treatment performance data were transferred.

+ The values shown on this table for treatment standards have been rounded to show significant figures only.

NA Not applicable since treatment performance data were not transferred to this constituent.

TABLE 6-5
CALCULATION OF NONWASTEWATER TREATMENT STANDARDS FOR
ORGANIC CONSTITUENTS IN K052

Regulated Constituent	Constituent* from Which Data Were Transferred*	Untreated Concentration** (ppm)	Technology Basis	Arithmetic Average of Corrected Treatment Values (ppm)	Variability Factor(VF)	Treatment Standards* (Average X VF) (ppm)
Volatiles						
4. Benzene	Toluene	22-12	Incineration	2.7	1.5	3.9
226. Ethylbenzene	Ethylbenzene	28 - 64	Solvent Extraction	0.06	1.2	0.08
43. Toluene	Toluene	22-12	Incineration	2.7	1.5	3.9
215.-217. Xylenes	Xylenes	<14-120	Incineration	3.4	2.5	8.5
Semivolatiles						
62. Benzo(a)pyrene	Benzo(a)pyrene	<2.72 - 3.5	Solvent Extraction	0.49	2.8	1.4
81. o-Cresol	p-Cresol	3.0 - 7.9	Solvent Extraction	2.9	2.3	6.8
82. p-Cresol	p-Cresol	3.0 - 7.9	Solvent Extraction	2.9	2.3	6.8
121. Naphthalene	Naphthalene	93-170	Incineration	0.3	2.8	0.84
141. Phenanthrene	Phenanthrene	77-120	Incineration	0.3	2.8	0.84
142. Phenol	Phenol	2.1 - 9.4	Solvent Extraction	1.9	2.2	4.3

* Data were transferred from K048 and K051.

** This is the concentration of each constituent in untreated K048 and K051 from which treatment performance data were transferred.

+ The values shown on this table for treatment standards have been rounded to show significant figures only.

TABLE 6-6
CALCULATION OF WASTEWATER TREATMENT STANDARDS
FOR CYANIDE IN K048-K052*

Regulated Constituent	Untreated Concentration** (ppm)	Technology Basis	Arithmetic Average of Corrected Treatment Values (ppm)	Variability Factor(VF)	Treatment Standard+ (Average X VF) (ppm)
<u>Inorganics</u>					
169. Cyanide	<0.06 - 7.9	Incineration	0.01	2.8	0.028

* Treatment performance data for cyanide in K048 were transferred to K049, K050, K051, and K052.

** This is the concentration of each constituent in untreated K048 and K051 from fluidized bed incineration.

+ The values shown on this table for treatment standards have been rounded to show significant figures only.

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1. Jacobs Engineering Company. 1979. Alternatives for Hazardous Waste Management in the Petroleum Refining Industry.
2. Environmental Resources Management, Inc. 1983. 1982 Refinery Solid Waste Survey. Prepared for the American Petroleum Institute.
3. Rosenberg, D.G. 1976. Assessment of Hazardous Waste Practices in the Petroleum Refining Industry. Pasadena, CA: Jacobs Engineering Company.
4. Cantrell, Aileen. 1987. "Annual Refining Survey." Oil and Gas Journal. 85(13).
5. U.S. EPA. 1981. U.S. Environmental Protection Agency, Office of Solid Waste. Identification and Listing of Hazardous Waste Under RCRA, Subtitle C, Section 3001, Background Document. Washington, D.C.: U.S. Environmental Protection Agency.
6. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite Engineering Report of Treatment Technology Performance and Operation for Amoco Oil Company, Whiting, Indiana. Washington, D.C.: U.S. Environmental Protection Agency.
7. U.S. EPA. February 19, 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite Engineering Report of Stabilization of Fluidized Bed Incineration Ash at Waterways Experiment Station, Vicksburg, Mississippi. Washington, D.C.: U.S. Environmental Protection Agency.
8. U.S. EPA. July 15, 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite Engineering Report of Treatment Technology Performance and Operation for Amoco Oil Company, Whiting, Indiana. Washington, D.C.: U.S. Environmental Protection Agency.
9. Sohio Oil Co. 1987. Demonstration of a Solvent Extraction Process for Treating Listed Petroleum Refinery Wastes. Submitted to U.S. EPA on June 12, 1987.
10. Resources Conservation Co. 1987. B.E.S.T. Clean Up, BDAT Performance Test Results. Submitted to U.S. EPA on May 19, 1987.
11. Jones, H.R. 1973. Pollution Control in the Petroleum Industry. Park Ridge, NJ: Noyes Data Corp.
12. Gloyna, E., and D. Ford. 1970. The Characteristics and Pollutational Problems Associated with Petrochemical Wastes. Austin, TX: Engineering Science, Inc.

13. U.S. EPA. February 22, 1988. U.S. Environmental Protection Agency, Office of Solid Waste, Final Characterization Report of Waste Characterization for Conoco, Inc., Ponca City, Oklahoma. Washington, D.C.: U.S. Environmental Protection Agency.
14. Delisting Petition #503.
15. Environ Corporation. Characterization of Waste Streams Listed in the 49 CFR Section 261 Waste Profiles. U.S. EPA, Office of Solid Waste, Waste Identification Branch, Characterization and Assessment Division. Washington, D.C.: U.S. Environmental Protection Agency.
16. Delisting Petition #205.
17. Delisting Petition #386.
18. Delisting Petition #396.
19. Delisting Petition #421.
20. Delisting Petition #469.
21. Delisting Petition #481.
22. Askew, M.W., et al. 1983. "Meet Environmental Needs for Refinery Expansions." Hydrocarbon Processing. October 1983: 65-70.
23. Delisting Petition #530.
24. Delisting Petition #264.
25. Delisting Petition #426.
26. American Petroleum Institute, 1988. API Comments on EPA's proposed rule, "Land Disposal Restriction for First Third of Scheduled Wastes." Submitted to EPA RCRA Docket F-88-LDR7-FFFFF. Comment No. L0008A. Washington, D.C.: U.S. Environmental Protection Agency.
27. U.S. EPA. 1986. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite Engineering Report of Treatment Technology Performance and Operation for Envirite Corporation. Washington, D.C.: U.S. Environmental Protection Agency.
28. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite Engineering Report for Horsehead Resource Development Company for K061. Washington, D.C.: U.S. Environmental Protection Agency.
29. BP Oil Company. 1987. BP Oil Company - Alliance Refinery Petition for the Exclusion from Hazardous Waste Regulation of a Solid Waste Residue

from the Solvent Extraction Treatment of Petroleum Refining Wastes.
Submitted to U.S. EPA on October 28, 1987.

30. CF Systems Corporation. 1987. Company Literature: CF Systems Units to Render Refinery Wastes Non-Hazardous. Waltham, MA: CF Systems Corporation.
31. Windholz, Martha, editor. 1983. The Merck Index, 10th edition. Rathway, NJ: Merck & Company.
32. Verschuieren, Karel. 1983. Handbook of Environmental Data on Organic Chemicals. 2nd edition. pp 575-576. New York: Van Nostrand Reinhold Company, Inc.
33. Weast, R.C., editor. 1980. CRC Handbook of Chemistry and Physics, 61st edition. p. C-134. Boca Raton, FL: CRC Press, Inc.
34. Dean, J.A., editor. 1979. Lange's Handbook of Chemistry, 12th edition. pp 10-118-9. New York: McGraw-Hill.
35. Sanderson, R.T. 1971. Chemical Bonds and Bond Energy. Volume 21 in Physical Chemistry. New York: Academic Press.
36. BP America, 1988. BPA Comments on EPA's proposed rule, "Land Disposal Restriction for First Third of Scheduled Wastes." Submitted to EPA RCRA Docket F-88-LDR7-FFFFF. Comment No. L08800176. Washington, D.C.: U.S. Environmental Protection Agency.
37. Resources Conservation Company, 1988. RCC Comments on EPA's proposed rule, "Land Disposal Restriction for First Third of Scheduled Wastes." Submitted to EPA RCRA Docket F-88-LDR7-FFFFF. Comment No. LDR700025. Washington, D.C.: U.S. Environmental Protection Agency.
38. CF Systems Corporation, 1988. CF Systems Comments on EPA's proposed rule, "Land Disposal Restriction for First Third of Scheduled Wastes." Submitted to EPA July 15, 1988. Washington, D.C.: U.S. Environmental Protection Agency.
39. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Research and Development, Hazardous Waste Engineering Research Laboratory. Binder Characterization for the USEPA's Evaluation of Solidification/Stabilization as a BDAT. Cincinnati, OH: U.S. Environmental Protection Agency.
40. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Final Best Demonstrated Available Technology (BDAT) Background Document for K048, K049, K050, K051, and K052. Washington, D.C.: U.S. Environmental Protection Agency.

41. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Methodology for Developing BDAT Treatment Standards. Washington, D.C.: U.S. Environmental Protection Agency.
42. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Characterization Report for K048 and K051 Amoco Oil Company, Whiting, Indiana. p. 3-8-3-9. Washington, D.C.: U.S. Environmental Protection Agency.
43. U.S. EPA. 1989. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite Engineering Report of Treatment Technology Performance and Operation for CF Systems, Waltham, Massachusetts. Washington, D.C.: U.S. Environmental Protection Agency.
44. Exxon Company, U.S.A. 1989. Refinery Waste Solvent Tests: Review of results presented to the U.S. Environmental Protection Agency. Submitted to U.S. EPA September 26, 1989.
45. American Petroleum Institute. 1989. Evaluation of BDAT Standards for Petroleum Refining Wastes Using New Waste and Treatment Data. Submitted to U.S. EPA.
46. CF Systems. 1988. Data submitted to the U.S. Environmental Protection Agency (USEPA) concerning treatment of the refinery waste codes K048-K052.
47. U.S. EPA. 1988. U.S. Environmental Protection Agency, Office of Solid Waste. Final Onsite Engineering Report of Treatment Technology Performance and Operation for Amoco Oil Company, Whiting, Indiana. Washington, D.C.: U.S. Environmental Protection Agency.

Table A-1

REVISED SUMMARY OF PETROLEUM REFINERY PLANT CODES

<u>Plant Code</u>	<u>Plant Name</u>	<u>Data Source</u>
A	Amoco Oil Company, Whiting Refinery Whiting, Indiana	EPA Testing (References 6 and 8)
B	Unknown	API Report (Reference 26)
C	Unknown	API Report (Reference 26)
D	Unknown	API Report (Reference 26)
E	Unknown	API Report (Reference 26)
F	Unknown	API Report (Reference 26)
G	General Refining Superfund Site Garden City, Georgia	Resources Conservation Company (Reference 37)
H	Unknown	API Report (Reference 26)
I	USAE Waterways Experiment Station Vicksburg, Mississippi	EPA Testing (Reference 7)
J	Unknown	API Report (Reference 26)
K	SOHIO Oil, Alliance Refinery, (Pilot plant results), Belle Chasse, Louisiana	BP America (Reference 29)
L	Unknown	CF Systems (Reference 30)
M	SOHIO Oil Alliance Refinery (full-scale results), Belle Chasse, Louisiana	BP America (Reference 36)

Table A-1 (Continued)

SUMMARY OF PETROLEUM REFINERY PLANT CODES

<u>Plant Code</u>	<u>Plant Name</u>	<u>Data Source</u>
N	Unknown	API Report (Reference 26)
O	Unknown	CF Systems (Reference 38)
P	Envirite Corporation York, Pennsylvania	EPA Testing (Reference 27)
Q	Waterways Experiment Station Vicksburg, Mississippi	EPA Testing (Reference 43)
R	Exxon Refineries (Location Unknown)	CF Systems and Resources Conservation Company (Reference 44)
S	Unknown	American Petroleum Institute (Reference 45)
T	Petro Canada Montreal, Quebec	CF Systems (Reference 47)

Appendix B
ANALYTICAL QA/QC

ANALYTICAL QA/QC

This appendix identifies the analytical methods used for analysis of the BDAT List organic constituents in the nonwastewater residual from the solvent extraction test conducted by the Agency and cyanide in the wastewater residual from the incineration test conducted by the Agency. Table B-1 presents the methods used for the analysis of the volatile and semivolatile organic constituents and cyanide. Only SW-846 Methods (EPA's Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846) were used for determining total constituent concentrations.

In some instances, it was necessary to deviate from the SW-846 methods. These deviations are given below:

- o Table B-2: specific procedures used in extraction of organic compounds when alternatives to SW-846 methods are allowed by approval of EPA's Characterization and Assessment division.
- o Table B-3: specific procedures or equipment used in extraction of organic compounds when alternatives or equivalents are allowed in the SW-846 methods.
- o Table B-4: specific procedures or equipment used for analysis of organic compounds and cyanide when alternatives or equivalents are allowed in SW-846 methods.

The accuracy determination for the BDAT List organic constituents is based on the matrix spike recoveries and on the matrix spike duplicate recoveries. These results are given in Table B-5. Results for the laboratory duplicate injections are given in Table B-6.

Table B-7 gives calibration procedures specified in SW-846 to analyze BDAT List organic constituents and cyanide, and Table B-8 gives the sources and purity of calibration standards. Table B-9 gives the source and/or purity of system performance check compounds and calibration check standards. Table B-10 gives the purity of solvents and acids used.

In order to account for inaccuracies due to matrix interferences in the data on the treated waste, accuracy correction factors for the BDAT list organic constituents and cyanide are presented in Table B-11.

TABLE B-1

ANALYTICAL METHODS

Analysis/Methods	Method
VOLATILE ORGANICS	
Purge-and-Trap	5030
Gas Chromatography/Mass Spectrometry for Volatile Organics	8240
SEMIVOLATILE ORGANICS	
Gel Permeation Chromatography (GPC)	3640
Sonication Extraction	3550
Gas Chromatography/Mass Spectroscopy for Semivolatile Organics: (Capillary Column Technique)	8270
Continuous Liquid-Liquid Extraction	3520
INORGANICS	
Cyanide	9010

REFERENCE: U.S. EPA, Test Methods for Evaluating Solid Waste, SW-846 Third Edition, Office of Solid Waste and Emergency Response, Washington, D.C., November 1986.

Table B-2

SPECIFIC PROCEDURES USED IN EXTRACTION OF ORGANIC COMPOUNDS WHEN ALTERNATIVES TO
SV-846 METHODS ARE ALLOWED BY APPROVAL OF EPA CHARACTERIZATION AND ASSESSMENT DIVISION

Analysis	SV-846 method	Sample aliquot	SV-846 specification	Specific procedures allowed by approval of EPA-CAD
Continuous liquid-liquid extraction	3520	1 liter	The internal standards are prepared by dissolution in carbon disulfide and then dilution to such volume that the final solvent is 20% carbon disulfide and 80% methylene chloride.	The preparation of the internal standards is changed to eliminate the use of carbon disulfide. The internal standards are prepared in methylene chloride only.
Sonication extraction	3550	1 gram for high concentrations and 30 grams for low concentrations	The internal standards are prepared by dissolution in carbon disulfide and then dilution to such volume that the final solvent is 20% carbon disulfide and 80% methylene chloride.	The preparation of the internal standards is changed to eliminate the use of carbon disulfide. The internal standards are prepared in methylene chloride only.

Table B-3

SPECIFIC PROCEDURES OR EQUIPMENT USED IN EXTRACTION OF ORGANIC COMPOUNDS WHEN
ALTERNATIVES OR EQUIVALENTS ARE ALLOWED IN THE SM-846 METHODS

Analysis	SM-846 method	Sample aliquot	Alternatives or equivalents allowed by SM-846 methods	Specific procedures or equipment used
Purge-and-trap	5030	5 milliliters of liquid; 1 gram of solid	- The purge-and-trap device to be used is specified in Figure 1 of the method. The desorbent to be used is described in Figures 2 and 3, and the packing materials are described in Section 4.10.2 of SM-846. The method allows equivalents of this equipment or materials to be used. - The method specifies that the trap must be at least 25 cm long and have an inside diameter of at least 0.105 cm. - The surrogates recommended are toluene-d₈, 4-bromofluorobenzene, and 1,2-dichloroethane-d₄. The recommended concentration level is 50 µg/l.	- The purge-and-trap equipment and the desorbent used are as specified in SM-846. The purge-and-trap equipment is a Techemar LSC-2 with standard purging chambers (Supelco cat. 2-0293). The packing materials for the traps are 1/3 silica gel and 2/3 2,6-diphenylene. - The length of the trap is 30 cm and the diameter is 0.105 cm. - The surrogates are added as specified in SM-846.
Sonication extraction	3550	1 gram of solid for high concentrations and 30 grams for low concentrations	- The recommended surrogates and their concentrations are the same as for Method 3520. - Sample grinding may be required for sample not passing through a 1-mm standard sieve or a 1-mm opening.	- The surrogates used and their concentration levels are the same as for Method 3520. - Sample grinding is not required.

Table B-3 (Continued)

SPECIFIC PROCEDURES OR EQUIPMENT USED IN EXTRACTION OF ORGANIC COMPOUNDS WHEN
ALTERNATIVES OR EQUIVALENTS ARE ALLOWED IN THE SW-846 METHODS

Analysis	SW-846 method	Sample aliquot	Alternatives or equivalents allowed by SW-846 methods	Specific procedures or equipment used
Continuous liquid- liquid extraction	3520	1 liter of liquid	• Acid and base/neutral extracts are usually combined before analysis by GC/MS. Under some situations, however, they may be extracted and analyzed separately. • The base/neutral surrogates recommended are 2-fluorobiphenyl, nitrobenzene-d5, and terphenyl-d14. The acid surrogates recommended are 2-fluorophenol, 2,4,6-tribromophenol, and phenol-d6. Additional compounds may be used for surrogates. The recommended concentrations for low-medium concentration level samples are 100 ppm for acid surrogates and 200 ppm for base/neutral surrogates. Volume of surrogate may be adjusted.	• Acid and base/neutral extracts are combined. • Surrogates are the same as those recommended by SW-846, with the exception that phenol-d5 is substituted for phenol-d6. The concentrations used are the concentrations recommended in SW-846.

Table B-4

SPECIFIC PROCEDURES OR EQUIPMENT USED IN ANALYSIS OF ORGANIC COMPOUNDS AND
CYANIDE WHEN ALTERNATIVES OR EQUIVALENTS ARE ALLOWED IN THE SW-846 METHODS

Analysis	SW-846 method	Sample preparation method	Alternatives or equivalents allowed in SW-846 for equipment or in procedure	Specific equipment or procedures used
Gas chromatography/ mass spectrometry for volatile organics	8240	5030	Recommended GC/MS operating conditions: Electron energy: 70 ev (nominal) Mass range: 35-260 amu Scan time: To give 5 scans/peak but not to exceed 7 sec/scan Initial column temperature: 45°C Initial column holding time: 3 min Column temperature program: 8°C/min Final column temperature: 200°C Final column holding time: 15 min Injector temperature: 200-225°C Source temperature: According to manufacturer's specification Transfer line temperature: 250-300°C Carrier gas: Hydrogen at 50 cm/sec or helium at 30 cm/sec The column should be 6 ft x 0.1 in I.D. glass, packed with 1% SP-1000 on Carbowack B (60/80 mesh) or an equivalent. Samples may be analyzed by purge-and-trap technique or by direct injection.	Actual GC/MS operating conditions: Electron energy: 70 ev Mass range: 35-260 amu Scan time: 2.5 sec/scan Initial column temperature: 38°C Initial column holding time: 2 min Column temperature program: 10°C/min Final column temperature: 225°C Final column holding time: 30 min or xylene elutes Injector temperature: 225°C Source temperature: Manufacturer's recommended value of 100°C Transfer line temperature: 275°C Carrier gas: Helium at 30 ml/min The column used is an 8 ft x 0.1 in I.D. glass, packed with 1% SP-1000 on Carbowack B (60/80 mesh). The samples are analyzed using the purge-and-trap technique. Additional information on actual system used: Equipment: Finnegan model 5100 GC/MS/DS system Data system: SUPERMOS Autoquan Mode: Electron impact MS library available Interface to MS - Jet separator

Table B-4. (Continued)

SPECIFIC PROCEDURES OR EQUIPMENT USED IN ANALYSIS OF ORGANIC COMPOUNDS AND CYANIDE WHEN ALTERNATIVES OR EQUIVALENTS ARE ALLOWED IN THE SW-846 METHODS

Analysis	SW-846 method	Sample preparation method	Alternatives or equivalents allowed in SW-846 for equipment or in procedure	Specific equipment or procedures used
Gas chromatography/mass spectrometry for semivolatile organics: capillary column technique	8270	3520-Liquids 3550, 3640-solids		
Recommended GC/MS operating conditions:				Actual GC/MS operating conditions:
Mass range:				35-500 amu
Scan time:				1 sec/scan
Initial column temperature:				30°C
Initial column holding time:				4 min
Column temperature program:				8°C/min to 275°C and 10°C/min until 305°C
Final column temperature hold:				305°C
Injector temperature:				240-260°C
Transfer line temperature:				300°C
Source temperature:				Manufacturer's recommendation (nonheated)
Injector:				Grob-type, splitless
Sample volume:				1 µl of sample extract
Carrier gas:				Helium at 40 cm/sec
Mass range:				35-500 amu
Scan time:				1 sec/scan
Initial column temperature:				40°C
Initial column holding time:				4 min
Column temperature program:				40-270°C at 10°C/min
Final column temperature hold:				270°C (until benzo[g,h,i.]perylene has eluted)
Injector temperature:				250-300°C
Transfer line temperature:				250-300°C
Source temperature:				According to manufacturer's specification
Injector:				Grob-type, splitless
Sample volume:				1-2 µl
Carrier gas:				Hydrogen at 50 cm/sec or helium at 30 cm/sec
The column should be 30 m by 0.25 mm I.D., 1-µm film thickness silicon-coated fused silica capillary column (J&W Scientific DB-5 or equivalent).				The column used is a 30 m x 0.32 mm I.D. RI _x -5 (5% phenyl methyl silicone) FSCC.
Additional information on actual system used:				Equipment: Finnegan model 5100 GC/MS/DS system Software Package: SUPERIMCDS Autoquan

Table B-4 (Continued)

SPECIFIC PROCEDURES OR EQUIPMENT USED IN ANALYSIS OF ORGANIC COMPOUNDS AND CYANIDE WHEN ALTERNATIVES OR EQUIVALENTS ARE ALLOWED IN THE SW-846 METHODS

Analysis	SW-846 method	Sample preparation method	Alternatives or equivalents allowed in SW-846 for equipment or in procedure	Specific equipment or procedures used
Gel permeation clean-up	3640		The column can be calibrated either manually or automatically.	The column is calibrated automatically using a UV detector with a flow through cell.
Total and Asenble Cyanide	8010		Hydrogen sulfide treatment may be required. A Fisher-Mulligan absorber or equivalent should be used.	Hydrogen sulfide treatment was required. A Fisher-Mulligan absorber was used.

Table B-5

MATRIX SPIKE RECOVERIES USED TO CORRECT TREATMENT PERFORMANCE DATA FOR ORGANICS IN
NONWASTEWATERS FROM SOLVENT EXTRACTION AT PLANT Q AND FOR CYANIDE IN
WASTEWATERS FROM INCINERATION AT PLANT A

BDAT List Spike # Constituent	Original Amount Found* (ppm)	Matrix Spike			Percent Recovery (%)	Matrix Spike Duplicate			Relative Percent Difference (%)
		Amount Spiked (ppm)	Amount Recovered (ppm)	Amount Spiked (ppm)		Amount Recovered (ppm)	Percent Recovery (%)		
VOLATILES									
24. 1,1-Dichloroethene	ND	0.05	0.032		64	0.05	0.028	56	13
47. Trichloroethene	ND	0.05	0.051		102	0.05	0.047	94	8
4. Benzene	0.013	0.05	0.053		80	0.05	0.040	54	39
43. Toluene	0.045	0.05	0.095		100	0.05	0.050	9	166
9. Chlorobenzene	ND	0.05	0.055		110	0.05	0.051	101	9
38. Methylene Chloride	ND	0.05	0.092		184	0.05	0.055	110	50
45. 1,1,1-Trichloroethene	ND	0.05	0.062		124	0.05	0.055	110	12
229. 4-Methyl-2-pentanone	ND	0.05	0.061		122	0.05	0.044	87	33
215. - 217. Total Xylenes	0.009	0.05	0.057		96	0.05	0.046	73	27
				3				86	
AVERAGE:					109				
SEMI-VOLATILES									
142. Phenol	1.83	13.3	12.9		83	13.3	10.2	63	27
78. 2-Chlorophenol	ND	13.3	8.14		61	13.3	5.6	42	37
99. 1,4-Dichlorobenzene	ND	6.67	3.05		46	6.64	1.18	18	88
105. n-Nitroso-di-n-propylamine	ND	6.67	4.14		62	6.64	3.76	57	8
150. 1,2,4-Trichlorobenzene	ND	6.67	3.66		55	6.64	3.09	47	16
76. 4-Chloro-3-methylphenol	ND	13.3	9.2		69	13.3	12.8	96	33
52. Acenaphthene	ND	6.67	3.75		56	6.64	4.48	67	18
127. 4-Nitrophenol	ND	13.3	8.67		65	13.3	14.6	110	51
102. 2,4-Dinitrotoluene	ND	6.67	4.51		68	6.64	5.54	83	20
139. Pentachlorophenol	ND	13.3	10.6		80	13.3	12.4	93	15
145. Pyrene	0.402	6.67	6.2		87	6.64	7.7	110	23
				3				77	
AVERAGE:					67				

Table B-5 (Continued)

MATRIX SPIKE RECOVERIES USED TO CORRECT TREATMENT PERFORMANCE DATA FOR ORGANICS IN
NONWASTEWATERS FROM SOLVENT EXTRACTION AT PLANT Q AND FOR CYANIDE IN
WASTEWATERS FROM INCINERATION AT PLANT A

BDAT List Spike # Constituent	Original Amount Found* (ppm)	Matrix Spike			Matrix Spike Duplicate			Relative Percent Difference (%)
		Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery (%)	Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery (%)	
INORGANICS								
169. Cyanide	ND	0.1	0.102	102	0.1	0.104	104	1.9

¹ Percent recovery = $100((C_i - C_o)/C_t)$, where C_o is the concentration of the original amount found, C_i is the concentration of the amount recovered, and C_t is the concentration of the amount spiked.

² Relative percent difference = $((D1 - D2)/((D1 + D2)/2))100$, where $D1$ is the larger of the two amounts recovered.

³ Percent recoveries less than 20% are not acceptable for this program and were not included in calculating the average percent recovery.

ND Not detected. Detection limits are presented in Appendix D.

* For constituents not detected above the detection limit (ND), the original amount found was considered zero in calculating percent recovery.

Table 8-6

LABORATORY DUPLICATE INJECTION ANALYSIS FOR ORGANICS IN NONWASTEWATERS
FROM SOLVENT EXTRACTION AT PLANT Q AND FOR CYANIDE IN WASTEWATERS
FROM INCINERATION AT PLANT A

BOAT List Spike Constituent	Matrix Spike Sample Result (ppm)	Matrix Spike Duplicate Injection Sample Result (ppm)	Relative Percent Difference* (%)
SEMI-VOLATILES			
142. Phenol	12.90	14.70	15
78. 2-Chlorophenol	8.14	8.40	3
99. 1,4-Dichlorobenzene	3.05	3.16	4
105. n-Nitroso-di-n-propylamine	4.14	4.23	3
150. 1,2,4-Trichlorobenzene	3.66	3.76	3
76. 4-Chloro-3-methylphenol	9.20	12.10	27
52. Acenaphthene	3.75	3.80	2
127. 4-Nitrophenol	8.67	10.80	22
102. 2,4-Dinitrotoluene	4.51	5.58	22
139. Pentachlorophenol	10.60	12.00	12
145. Pyrene	6.20	5.80	7
INORGANICS			
169. Cyanide	0.102	NA	NA

* Relative percent difference = $(MS-DI)/(MS+DI)/2 \times 100$,
where MS is the sample result for the matrix spike sample
and DI is the sample result for the duplicate injection
sample.

NA Not analyzed.

Table B-7

CALIBRATION PROCEDURES SPECIFIED IN SW-846 TO ANALYZE
ORGANIC BOAT LIST CONSTITUENTS AND CYANIDE

Analysis	SW-846 method	Standards	Calibration procedures
Gas chromatography/ mass spectrometry (GC/MS) for volatile organics	8240	- The internal standards are bromochloromethane, 1,4-difluorobenzene, and chlorobenzene-d5. The concentration is 50 ug/l. - Calibration standards are a mixture of all available BOAT volatile compounds. - Check standard is bromofluorobenzene (BFB). - Calibration check compounds (CCCs) are chloroform, 1,2-dichloropropane, toluene, ethylbenzene, vinyl chloride and 1,1-dichloroethane. - System performance check compounds (SPCCs) are chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene.	- The internal standards are added to each sample to check performance of GC/MS. - Concentration of standards for calibration curve are 20, 50, 100, 150, and 200 ug/l. Calibration curve is run when continuing calibration does not meet criteria. This meets the requirements in SW-846. - Check standard is run every 12 hours as specified in method 8240. - CCCs at 50 ug/l are run every 12 hours. This meets the requirements in SW-846. - SPCCs as specified in the method are run initially as specified in the method are run initially to ensure minimum average response factor of 0.3. The concentrations of the SPCCs are at 50 ppb. The SPCCs are repeated every 12 hours. This meets the requirements in SW-846.

Table B-7 (Continued)

CALIBRATION PROCEDURES SPECIFIED IN SW-846 TO ANALYZE
ORGANIC BOAT LIST CONSTITUENTS AND CYANIDE

Analysis	SW-846 method	Standards	Calibration procedures
Gas chromatography/ mass spectrometry for semivolatile organics	8270	- Internal standards used are 1,4-dichlorobenzene-d4, naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12. - Calibration standards are a mixture of all available BOAT semivolatile constituents. - Check standard is decafluoro-triphenylphosphine (DFTPP). - The calibration check compounds (CCCs) are phenol, 1,4-dichlorobenzene, 2-nitrophenol, 2,4-dichlorophenol, hexachlorobutadiene, 4-chloro-3-methyl phenol, 2,4,6-trichlorophenol, acenaphthene, benzo(a)pyrene, di-n-octyl phthalate, fluoranthene, N-nitrosodi-N-phenylamine, and pentachlorophenol.	- The concentration of each internal standard is 40 ug/ml. These standards are added to each sample to check performance of GC/MS. This meets the requirements in SW-846. - The concentration of standards for calibration are 20, 50, 80, 120, and 160 ug/l. Calibration curve is run when GS/MS system does not meet the daily continuing calibration checks. This meets the requirements in SW-846. - Daily checks as specified in SW-846 are completed for DFTPP to determine whether spectrum meets criteria specified in method. - The CCCs are run every 12 hours. This meets the requirements in SW-846.

Table B-7 (Continued)

CALIBRATION PROCEDURES SPECIFIED IN SW-846 TO ANALYZE
ORGANIC BDAT LIST CONSTITUENTS AND CYANIDE

Analysis	SW-846 method	Standards	Calibration procedures
		The system performance check compounds (SPCCs) are M-nitrosodi-n-propylamine, hexachlorocyclopentadiene, 2,4-dinitrophenol, and 4-nitrophenol. These are the SPCCs recommended in SW-846.	The concentrations of the SPCCs are 50 ug/l. The system performance (i.e., the GC) is verified initially to ensure a minimum average response factor of 0.05 for the SPCCs. The SPCCs are run every 12 hours for duration of project. This meets the requirements in SW-846.
Total and Amenable Cyanide	9010	- Calibration standard was cyanide.	- The five calibration standards used were 0.5, 0.4, 0.3, 0.2, 0.1 mg/l, and a blank. - The calibration curve was run once per day. - The check standard was 0.3 ug/l for all samples. The frequency of running the check standard was 10 percent.

Table B-8

SOURCE AND PURITY OF CALIBRATION STANDARDS

BDAT ref. no.	Constituents	Source for standards	Purity or grade or concentration
<u>Volatile Organics</u>			
222	Acetone	Supelco	200 µg/ml
1	Acetonitrile	Chem Service	99+
2	Acrolein	Chem Service	97%
3	Acrylonitrile	Chem Service	99+%
4	Benzene	Supelco	200 µg/ml
5	Bromodichloromethane	Supelco	200 µg/ml
6	Bromomethane	Supelco	200 µg/ml
7	Carbon tetrachloride	Supelco	200 µg/ml
8	Carbon disulfide	Supelco	200 µg/ml
9	Chlorobenzene	Supelco	200 µg/ml
10	2-Chloro-1,3-butadiene	Alfa Products	Reagent Grade
11	Chlorodibromomethane	Supelco	200 µg/ml
12	Chloroethane	Supelco	200 µg/ml
13	2-Chloroethyl vinyl ether	Chem Service	99%
14	Chloroform	Supelco	200 µg/ml
15	Chloromethane	Supelco	200 µg/ml
16	3-Chloropropene	Aldrich	99%
17	1,2-Dibromo-3-chloropropane	Chem Service	Reagent Grade
18	1,2-Dibromoethane	Chem Service	99+%
19	Dibromomethane	Aldrich	99%
20	trans-1,4-Dichloro-2-butene	Aldrich	85+%
21	Dichlorodifluoromethane	Supelco	200 µg/ml
22	1,1-Dichloroethane	Supelco	200 µg/ml
23	1,2-Dichloroethane	Supelco	200 µg/ml
24	1,1-Dichloroethylene	Supelco	200 µg/ml
25	trans-1,2-Dichloroethene	Supelco	200 µg/ml
26	1,2-Dichloropropane	Supelco	200 µg/ml
27	trans-1,3-Dichloropropene	Supelco	200 µg/ml
28	cis-1,3-Dichloropropene	Supelco	200 µg/ml
29	1,4-Dioxane	Aldrich	Reagent Grade
226	Ethyl benzene	Supelco	200 µg/ml
30	Ethyl cyanide	Aldrich	Reagent Grade
31	Ethyl methacrylate	Aldrich	99%
214	Ethylene oxide	Eastman	99.7%
32	Iodomethane	Alfa Research Chem.	99%
33	Isobutyl alcohol	Aldrich	99+%
34	Methyl ethyl ketone	Supelco	200 µg/ml
229	Methyl isobutyl ketone	Supelco	200 µg/ml
35	Methyl methacrylate	Chem Service	99+%

Table B-8 (Continued)

SOURCE AND PURITY OF CALIBRATION STANDARDS

BDAT ref. no.	Constituents	Source for standards	Purity or grade or concentration
<u>Volatile Organics (continued)</u>			
37	Methylacrylonitrile	Aldrich	Reagent Grade
38	Methylene chloride	Supelco	200 µg/ml
39	Pyridine	Chem Service	99%
40	1,1,1,2-Tetrachloroethane	Chem Service	Reagent Grade
41	1,1,2,2-Tetrachloroethane	Supelco	200 µg/ml
42	Tetrachloroethene	Supelco	200 µg/ml
43	Toluene	Supelco	200 µg/ml
44	Tribromomethane	Supelco	200 µg/ml
45	1,1,1-Trichloroethane	Supelco	200 µg/ml
46	1,1,2-Trichloroethane	Supelco	200 µg/ml
47	Trichloroethene	Supelco	200 µg/ml
48	Trichloromonofluoromethane	Supelco	200 µg/ml
49	1,2,3-Trichloropropane	Chem Service	99+%
50	Vinyl chloride	Supelco	200 µg/ml
215- 217	Xylenes	Supelco	200 µg/ml
<u>Semivolatile Organics</u>			
51	Acenaphthylene	EPA	2 mg/ml
52	Acenaphthene	EPA	2 mg/ml
53	Acetophenone	Aldrich	99%
54	2-Acetylamino fluorene	Aldrich	Reagent Grade
55	4-Aminobiphenyl	Aldrich	98%
56	Aniline	Chem Service	Reagent Grade
57	Anthracene	EPA	2 mg/ml
58	Aramite	Chem Service	90%
59	Benz(a)anthracene	EPA	2 mg/ml
60	Benzenethiol	Aldrich	Reagent Grade
62	Benzo(a)pyrene	EPA	2 mg/ml
63	Benzo(b)fluoranthene	EPA	2 mg/ml
64	Benzo(ghi)perylene	EPA	2 mg/ml
65	Benzo(k)fluoranthene	EPA	2 mg/ml
66	p-Benzoquinone	Chem Service	Reagent Grade
67	Bis(2-chloroethoxy)methane	Pfaltz-Bauer	Reagent Grade
68	Bis(2-chloroethyl)ether	EPA	2 mg/ml
69	Bis(2-chloroisopropyl)ether	Chem Service	97.6%
70	Bis(2-ethylhexyl)phthalate	EPA	2 mg/ml
71	4-Bromophenyl phenyl ether	EPA	2 mg/ml
72	Butyl benzyl phthalate	EPA	2 mg/ml

Table B-8 (Continued)

SOURCE AND PURITY OF CALIBRATION STANDARDS

BOAT ref. no.	Constituents	Source for standards	Purity or grade or concentration
<u>Semivolatile Organics (continued)</u>			
73	2-sec-Butyl-4,6-dinitrophenol	Chem Service	99%
74	p-Chloroaniline	EPA	2 mg/ml
75	Chlorobenzilate	Chem Service	96%
76	p-Chloro-m-cresol	EPA	2 mg/ml
77	2-Chloronaphthalene	Aldrich	90%
78	2-Chlorophenol	EPA	2 mg/ml
80	Chrysene	Eastman Kodak	Reagent Grade
81	ortho-Cresol	EPA	2 mg/ml
82	para-Cresol	EPA	2 mg/ml
83	Dibenz(a,h)anthracene	EPA	2 mg/ml
84	Dibenzo(a,e)pyrene	Sigma Chemical	98%
86	m-Dichlorobenzene	EPA	2 mg/ml
87	o-Dichlorobenzene	EPA	2 mg/ml
88	p-Dichlorobenzene	EPA	2 mg/ml
89	3,3'-Dichlorobenzidine	EPA	2 mg/ml
90	2,4-Dichlorophenol	EPA	2 mg/ml
91	2,6-Dichlorophenol	EPA	2 mg/ml
92	Diethyl phthalate	EPA	2 mg/ml
93	3,3'-Dimethoxybenzidine	Aldrich	97%
94	p-Dimethylaminoazobenzene	Aldrich	Reagent Grade
95	3,3'-Dimethylbenzidine	EM Science	Reagent Grade
96	2,4-Dimethylphenol	EPA	2 mg/ml
97	Dimethyl phthalate	EPA	2 mg/ml
98	Di-n-butyl phthalate	EPA	2 mg/ml
99	1,4-Dinitrobenzene	Aldrich	98%
100	4,6-Dinitro-o-cresol	EPA	2 mg/ml
101	2,4-Dinitrophenol	EPA	2 mg/ml
102	2,4-Dinitrotoluene	EPA	2 mg/ml
103	2,6-Dinitrotoluene	EPA	2 mg/ml
104	Di-n-octyl phthalate	EPA	2 mg/ml
105	Di-n-propylnitrosamine	EPA	2 mg/ml
106/	Diphenylamine/	Aldrich	99%
219	Diphenylnitrosamine	Eastman Kodak	Reagent Grade
107	1,2-Diphenylnitrosamine	Chem Service	99+%
108	Fluoranthene	EPA	2 mg/ml
109	Fluorene	EPA	2 mg/ml
110	Hexachlorobenzene	EPA	2 mg/ml
111	Hexachlorobutadiene	EPA	2 mg/ml
112	Hexachlorocyclopentadiene	EPA	2 mg/ml
113	Hexachloroethane	EPP	2 mg/ml

Table B-8 (Continued)

SOURCE AND PURITY OF CALIBRATION STANDARDS

BOAT ref. no.	Constituents	Source for standards	Purity or grade or concentration
<u>Semivolatile Organics (continued)</u>			
114	Hexachlorophene	Chem Service	Reagent Grade
115	Hexachloropropene	Aldrich	96%
116	Indeno(1,2,3-cd)pyrene	EPA	2 mg/ml
117	Isosafrole	Fluka	95%
118	Methapyrilene	Sigma Chemical	Reagent Grade
119	3-Methylcholanthrene	Aldrich	98%
120	4,4'-Methylenebis (2-chloroaniline)	Chem Service	Reagent Grade
36	Methyl methanesulfonate	Aldrich	99%
121	Naphthalene	EPA	2 mg/ml
122	1,4-Naphthoquinone	Aldrich	97%
123	1-Naphthylamine	Chem Service	Reagent Grade
124	2-Naphthylamine	Aldrich	Reagent Grade
125	p-Nitroaniline	EPA	2 mg/ml
126	Nitrobenzene	EPA	2 mg/ml
127	4-Nitrophenol	EPA	2 mg/ml
128	N-Nitrosodi-n-butylamine	Chem Service	Reagent Grade
129	N-Nitrosodiethylamine	Chem Service	Reagent Grade
130	N-Nitrosodimethylamine	Chem Service	Reagent Grade
131	N-Nitrosomethylethylamine	Chem Service	Reagent Grade
132	N-Nitrosomorpholine	Chem Service	Reagent Grade
133	N-Nitrosopiperidine	Chem Service	Reagent Grade
134	n-Nitrosopyrrolidine	Aldrich	99%
135	S-Nitro-o-toluidine	Chem Service	High Purity
136	Pentachlorobenzene	Chem Service	Reagent Grade
137	Pentachloroethane	Aldrich	96%
138	Pentachloronitrobenzene	Chem Service	96%
139	Pentachlorophenol	EPA	2 mg/ml
140	Phenacetin	Chem Service	97%
141	Phenanthrene	Chem Service	High Purity
142	Phenol	EPA	2 mg/ml
143	2-Picoline	Aldrich	98%
144	Pronamide	Chem Service	98%
145	Pyrene	EPA	2 mg/ml
146	Resorcinol	Aldrich	98%
147	Safrole	Aldrich	97%
148	1,2,4,5-Tetrachlorobenzene	Aldrich	98%
149	2,3,4,6-Tetrachlorophenol	Chem Service	92%
150	1,2,4-Trichlorobenzene	EPA	2 mg/ml
151	2,4,5-Trichlorophenol	EPA	2 mg/ml
152	2,4,6-Trichlorophenol	EPA	2 mg/ml
153	Tris(2,3-dibromopropyl) phosphate	Chem Service	Reagent Grade

INORGANICS

189 Cyanide

Fisher 743410

Table B-9

SOURCE AND/OR PURITY OF SYSTEM PERFORMANCE CHECK
COMPOUNDS AND CALIBRATION CHECK STANDARDS

Compound	Source	Purity/grade
<u>System Performance Check Compounds for Method 8240</u>		
Chloromethane	Supelco	200 µg/ml
1,1-Dichloroethane	Supelco	200 µg/ml
Bromoform	Supelco	200 µg/ml
1,1,2,2-Tetrachloroethane	Supelco	200 µg/ml
Chlorobenzene	Supelco	200 µg/ml
<u>Calibration Check Compounds for Method 8240</u>		
1,1-Dichloroethene	Supelco	200 µg/ml
Chloroform	Chem Service	200 µg/ml
1,2-Dichloropropane	Chem Service	200 µg/ml
Toluene	KOR	200 µg/ml
Ethylbenzene	Chem Service	200 µg/ml
Vinyl chloride	EPA Materials Bank	200 µg/ml
<u>Internal Standards for Method 8240</u>		
Bromochloromethane	Supelco	1,000 µg/ml
1,4-Difluorobenzene	Aldrich	1,000 µg/ml
Chlorobenzene-d5	KOR	1,000 µg/ml
<u>Surrogates for Method 8240</u>		
Toluene-d8	Supelco	250 µg/l
Bromofluorobenzene	Supelco	250 µg/l
1,2-Dichloroethane-d4	Supelco	250 µg/l

Table B-9 (Continued)

SOURCE AND/OR PURITY OF SYSTEM PERFORMANCE CHECK
COMPOUNDS AND CALIBRATION CHECK STANDARDS

Compound	Source	Purity/grade
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System Performance Check Compounds for Method 8270

N-Nitrosodi-n-propylamine	EPA	2 mg/ml
Hexachlorocyclopentadiene	EPA	2 mg/ml
2,4-Dinitrophenol	EPA	2 mg/ml
4-Nitrophenol	EPA	2 mg/ml

Calibration Check Compounds for Method 8270

Acenaphthene	EPA	2 mg/ml
1,4-Dichlorobenzene	EPA	2 mg/ml
Hexachlorobutadiene	EPA	2 mg/ml
N-Nitrosodiphenyl amine	EPA	2 mg/ml
Di-n-octyl phthalate	EPA	2 mg/ml
Benzo(a)pyrene	EPA	2 mg/ml
4-Chloro-3-methylphenol	EPA	2 mg/ml
2,4-Dichlorophenol	EPA	2 mg/ml
2-Nitrophenol	EPA	2 mg/ml
Phenol	EPA	2 mg/ml
Pentachlorophenol	EPA	2 mg/ml
2,4,6-Trichlorophenol	EPA	2 mg/ml
Fluoranthene	EPA	2 mg/ml

Internal Standards for Method 8270

1,4-Dichlorobenzene-d4	KOR	98%
Naphthalene-d8	KOR	99%
Acenaphthalene-d10	KOR	98%
Phenanthrene-d10	KOR	98%
Chrysene-d12	KOR	98%
Perylene-d12	KOR	98%

Surrogates for Method 8270

Nitrobenzene-d5	KOR	99%
2-Fluorobiphenyl	Aldrich	97%
Terphenyl-d14	ICN	98%
Phenol-d8	Cambridge Isotope Labs	98%
2-Fluorophenol	Aldrich	97%
2,4,6-Tribromophenol	Chem Service	Reagent Grade

Table B-10

PURITY OF SOLVENTS AND ACIDS USED

Compound	Purity or quality
<u>Solvents</u>	
Methylene chloride	Pesticide/capillary grade ^a
Hexane	GC/capillary grade
2-Propanol	Pesticide/capillary grade
Cyclohexane	Pesticide/capillary grade
Methanol	GC/MS grade
<u>Acids</u>	
Hydrochloric acid	Fisher reagent grade
Sulfuric acid	Fisher reagent grade
Nitric acid	Baker Insta-analyzed
Acetic acid	Fisher reagent grade

^aThe pesticide/capillary grade methylene chloride is redistilled in glass to eliminate any impurities that may be present in the solvent.

Note: Reagent water is deionized by Versar's in-house system then distilled in glass, and finally purged while hot with high purity (99.9999%) helium.

Table B-11

SUMMARY OF ACCURACY CORRECTION FACTORS
FOR ORGANICS IN NONWASTEWATERS AND CYANIDE IN WASTEWATERS

BDAT #	BDAT List Constituent	Accuracy Correction Factor ^a
VOLATILES		
4.	Benzene	1.852
226.	Ethylbenzene	1.163
43.	Toluene	1
215.-217.	Xylene (total)	1.37
SEMIVOLATILES		
57.	Anthracene	1.493 *
59.	Benz(a)anthracene	1.493 *
121.	Napthalene	1.493 *
62.	Benzo(a)pyrene	1.493 *
145.	Pyrene	1.149
80.	Chrysene	1.493 *
142.	Phenol	1.587
141.	Phenanthrene	1.493 *
INORGANICS		
169.	Cyanide	1

^a The accuracy correction factor is equal to 1 divided by the percent recovery. Recoveries less than 20% are not acceptable for this program and were not included in calculating the accuracy correction factors.

* No matrix spike was performed for this constituent. The percent recovery for this constituent is based on the lower average percent recovery of the matrix spike and matrix spike duplicate for the semivolatile constituents. Recoveries less than 20% are not included in calculating the averages.

Appendix C

RESULTS OF THE STATISTICAL ANALYSIS TESTS
COMPARING SOLVENT EXTRACTION AT PLANT M TO
SOLVENT EXTRACTION AT PLANT Q

RESULTS OF STATISTICAL TESTS

Statistical tests were conducted to compare the treatment performance achieved by the three-cycle solvent extraction unit at plant M with treatment performance achieved by the extraction unit at Plant Q. Results of the statistical tests are summarized in Tables C-1 through C-3. Based on these calculations, the system at Plant Q performed significantly better than the system at Plant M for the following regulated constituents in K048-K052 nonwastewaters: anthracene, benz(a)anthracene, chrysene, di-n-butyl phthalate, ethylbenzene, phenanthrene, pyrene, toluene, and o-cresol. The system at Plant M performed significantly better than the system at Plant Q for the following regulated constituents: phenol and p-cresol.

A statistical comparison of treatment performance by the systems at Plants Q and M could not be performed for xylene and naphthalene because the treatment system at Plant M does not show treatment for xylene and naphthalene. The treatment system at Plant Q does demonstrate significant treatment for these constituents.

The Wilcoxon rank-sum test (Statistical Methods, Snedecor, G.W. and Cochran, W.G., 7th ed., p. 144) was used to perform the statistical comparison of these data. This test is an alternative statistical approach to the analysis of variance (ANOVA) test discussed in EPA's Methodology for Developing BDAT Treatment Standards (Reference 41). Two basic assumptions are made in performing an ANOVA: (1) the data are normally distributed and (2) the

variances from the data sets being compared are homogeneous. Due to the relatively small number of data points and the fact that a majority of the treated waste data consisted of non-detect values, it was difficult to assess whether these criteria were met. An alternative statistical approach which circumvents these problems is a non-parametric approach; this approach involves no assumptions about the underlying distribution of the data. Instead, the non-parametric approach involves ranking, or categorizing, the data and performing statistical tests on these ranks or categories. The non-parametric Wilcoxon rank-sum test basically consists of performing an ANOVA on the ranks of the data. Accordingly, the Wilcoxon rank-sum test was determined to be the appropriate method to use to compare the treatment performance data from the treatment systems at Plants M and Q.

Table C-1

RESULTS OF THE STATISTICAL COMPARISON OF SOLVENT EXTRACTION
AT PLANT M WITH SOLVENT EXTRACTION AT PLANT Q*

BDAT List Constituent	Plant M					Plant Q					Plant That Achieved Better Treatment
	Number of Samples	3-Cycle Solvent Extraction				Number of Samples	Solvent Extraction				
		Minimum	Maximum	Mean*	Median*		Minimum	Maximum	Mean*	Median*	
VOLATILE ORGANICS											
4. Benzene	6	<2	<6	1.583	1	4	0.16	0.42	0.247	0.21	Q
43. Toluene	6	<2	<6	1.583	1	4	0.27	0.94	0.508	0.41	Q
226. Ethylbenzene	6	<5	<30	7.283	5.6	4	0.06	0.07	0.04	0.03	Q
SEMIVOLATILE ORGANICS											
57. Anthracene	8	<2	<5	1.187	1	4	<0.49	<0.49	0.245	0.245	Q
59. Benz(a)anthracene	8	<0.7	1.2	0.777	0.8	4	<0.49	<0.49	0.245	0.245	Q
62. Benzo(a)pyrene	8	<0.6	0.75	0.509	0.48	4	<0.49	<0.49	0.245	0.245	Q
70. Bis(2-ethylhexyl)phthalate	8	<0.8	30	4.663	0.4	4	<0.49	<0.49	0.245	0.245	Q
80. Chrysene	8	<0.8	1.7	1.163	1.2	4	<0.49	0.63	0.341	0.245	Q
81. o-Cresol	8	<0.8	<0.8	0.4	0.4	4	<0.49	<0.49	0.245	0.245	Q
82. p-Cresol	8	1.3	4.7	2.9	3.05	4	<0.49	0.69	0.514	0.56	M
98. Di-n-butyl phthalate	8	<0.8	<2	0.55	0.4	4	1.17	2.86	1.92	1.825	Q
141. Phenanthrene	8	<0.8	1.5	1.025	0.9	4	<0.38	0.77	0.42	0.37	Q
142. Phenol	8	<0.8	0	0.4	0.4	4	<0.49	<0.49	0.245	0.245	M
145. Pyrene	8	<0.8	0.9	0.462	0.4	4	1.6	3.9	2.925	3.1	Q

* Plant codes are presented in Appendix A.

* Values below the detection limit were estimated at one-half the detection limit.

Table C-2

Ranks of the Data, by analyte
(ranks used for ANOVA)

1

----- ANALYTE=Anthracene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
1	CF	ND	0.49	0.245	2.5
2	CF	ND	0.49	0.245	2.5
3	CF	ND	0.49	0.245	2.5
4	CF	ND	0.49	0.245	2.5
5	BP	ND	2.00	1.000	8.0
6	BP	ND	2.00	1.000	8.0
7	BP	ND	2.00	1.000	8.0
8	BP	ND	2.00	1.000	8.0
9	BP	ND	2.00	1.000	8.0
10	BP	ND	2.00	1.000	8.0
11	BP	ND	2.00	1.000	8.0
12	BP	ND	5.00	2.500	12.0

----- ANALYTE=Benz(a)anthracene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
13	CF	ND	0.49	0.245	2.5
14	CF	ND	0.49	0.245	2.5
15	CF	ND	0.49	0.245	2.5
16	CF	ND	0.49	0.245	2.5
17	BP	ND	0.70	0.350	5.5
18	BP	ND	0.70	0.350	5.5
19	BP	0.7	.	0.700	7.0
20	BP	0.71	.	0.710	8.0
21	BP	0.89	.	0.890	9.0
22	BP	0.92	.	0.920	10.0
23	BP	1.1	.	1.100	11.0
24	BP	1.2	.	1.200	12.0

----- ANALYTE=Benzene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
25	CF	0.16	.	0.16	1.0
26	CF	0.18	.	0.18	2.0
27	CF	0.24	.	0.24	3.0
28	CF	0.41	.	0.41	4.0
29	BP	ND	2	1.00	6.5
30	BP	ND	2	1.00	6.5
31	BP	ND	2	1.00	6.5
32	BP	ND	2	1.00	6.5
33	BP	ND	5	2.50	9.0
34	BP	ND	6	3.00	10.0

Table C-2 (Continued)
Ranks of the Data, by analyte
(ranks used for ANOVA)

2

----- ANALYTE=Benzo(a)pyrene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
35	CF	ND	0.49	0.245	2.5
36	CF	ND	0.49	0.245	2.5
37	CF	ND	0.49	0.245	2.5
38	CF	ND	0.49	0.245	2.5
39	BP	ND	0.60	0.300	6.5
40	BP	ND	0.60	0.300	6.5
41	BP	ND	0.60	0.300	6.5
42	BP	ND	0.60	0.300	6.5
43	BP	0.66	.	0.660	9.0
44	BP	0.71	.	0.710	10.0
45	BP	0.75	.	0.750	11.5
46	BP	0.75	.	0.750	11.5

----- ANALYTE=Bis(2-ethylhexyl)phthalate -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
47	CF	ND	0.49	0.245	2.5
48	CF	ND	0.49	0.245	2.5
49	CF	ND	0.49	0.245	2.5
50	CF	ND	0.49	0.245	2.5
51	BP	ND	0.80	0.400	7.5
52	BP	ND	0.80	0.400	7.5
53	BP	ND	0.80	0.400	7.5
54	BP	ND	0.80	0.400	7.5
55	BP	ND	0.80	0.400	7.5
56	BP	ND	0.80	0.400	7.5
57	BP	4.9	.	4.900	11.0
58	BP	30	.	30.000	12.0

----- ANALYTE=Chrysene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
59	CF	ND	0.49	0.245	2
60	CF	ND	0.49	0.245	2
61	CF	ND	0.49	0.245	2
62	BP	ND	0.80	0.400	4
63	CF	0.63	.	0.630	5
64	BP	0.9	.	0.900	6
65	BP	1	.	1.000	7
66	BP	1.1	.	1.100	8
67	BP	1.3	.	1.300	9
68	BP	1.4	.	1.400	10
69	BP	1.5	.	1.500	11
70	BP	1.7	.	1.700	12

Table C-2 (Continued)
Ranks of the Data, by analyte
(ranks used for ANOVA)

3

----- ANALYTE=Di-n-butyl phthalate -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
71	CF	ND	0.49	0.245	2.5
72	CF	ND	0.49	0.245	2.5
73	CF	ND	0.49	0.245	2.5
74	CF	ND	0.49	0.245	2.5
75	BP	ND	0.80	0.400	8.5
76	BP	ND	0.80	0.400	8.5
77	BP	ND	0.80	0.400	8.5
78	BP	ND	0.80	0.400	8.5
79	BP	ND	0.80	0.400	8.5
80	BP	ND	0.80	0.400	8.5
81	BP	ND	0.80	0.400	8.5
82	BP	ND	0.80	0.400	8.5

----- ANALYTE=Ethylbenzene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
83	CF	ND	0.06	0.03	2.0
84	CF	ND	0.06	0.03	2.0
85	CF	ND	0.06	0.03	2.0
86	CF	0.07	.	0.07	4.0
87	BP	ND	5.00	2.50	5.5
88	BP	ND	5.00	2.50	5.5
89	BP	ND	10.00	5.00	7.0
90	BP	6.2	.	6.20	8.0
91	BP	ND	25.00	12.50	9.0
92	BP	ND	30.00	15.00	10.0

----- ANALYTE=Phenanthrene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
93	CF	ND	0.49	0.245	1
94	CF	0.52	.	0.520	2
95	CF	0.6	.	0.600	3
98	CF	0.69	.	0.690	4
97	BP	1.3	.	1.300	5
98	BP	1.4	.	1.400	6
99	BP	2.6	.	2.600	7
100	BP	3	.	3.000	8
101	BP	3.1	.	3.100	9
102	BP	3.4	.	3.400	10
103	BP	3.7	.	3.700	11
104	BP	4.7	.	4.700	12

Table C-2 (Continued)
Ranks of the Data, by analyte
(ranks used for ANOVA)

4

----- ANALYTE=Phenol -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
105	BP	ND	0.8	0.40	3.5
106	BP	ND	0.8	0.40	3.5
107	BP	ND	0.8	0.40	3.5
108	BP	ND	0.8	0.40	3.5
109	BP	ND	0.8	0.40	3.5
110	BP	ND	0.8	0.40	3.5
111	BP	ND	2.0	1.00	7.5
112	BP	ND	2.0	1.00	7.5
113	CF	1.17	.	1.17	9.0
114	CF	1.75	.	1.75	10.0
115	CF	1.9	.	1.90	11.0
116	CF	2.86	.	2.86	12.0

----- ANALYTE=Pyrene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
117	CF	ND	0.38	0.19	1.5
118	CF	ND	0.38	0.19	1.5
119	BP	ND	0.80	0.40	3.0
120	CF	0.55	.	0.55	4.0
121	CF	0.77	.	0.77	5.0
122	BP	0.8	.	0.80	6.0
123	BP	0.9	.	0.90	8.0
124	BP	0.9	.	0.90	8.0
125	BP	0.9	.	0.90	8.0
126	BP	1.3	.	1.30	10.0
127	BP	1.5	.	1.50	11.5
128	BP	1.5	.	1.50	11.5

----- ANALYTE=Toluene -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
129	CF	0.27	.	0.27	1.0
130	CF	0.37	.	0.37	2.0
131	CF	0.45	.	0.45	3.0
132	CF	0.94	.	0.94	4.0
133	BP	ND	2	1.00	6.5
134	BP	ND	2	1.00	6.5
135	BP	ND	2	1.00	6.5
136	BP	ND	2	1.00	6.5
137	BP	ND	5	2.50	9.0
138	BP	ND	6	3.00	10.0

Table C-2 (Continued)
Ranks of the Data, by analyte
(ranks used for ANOVA)

5

----- ANALYTE=o-Cresol -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
139	CF	ND	0.49	0.245	2.5
140	CF	ND	0.49	0.245	2.5
141	CF	ND	0.49	0.245	2.5
142	CF	ND	0.49	0.245	2.5
143	BP	ND	0.80	0.400	8.5
144	BP	ND	0.80	0.400	8.5
145	BP	ND	0.80	0.400	8.5
146	BP	ND	0.80	0.400	8.5
147	BP	ND	0.80	0.400	8.5
148	BP	ND	0.80	0.400	8.5
149	BP	ND	0.80	0.400	8.5
150	BP	ND	0.80	0.400	8.5

----- ANALYTE=p-Cresol -----

OBS	SOURCE	RESULT	DL	CONC	RANKS
151	BP	ND	0.8	0.4	4
152	BP	ND	0.8	0.4	4
153	BP	ND	0.8	0.4	4
154	BP	ND	0.8	0.4	4
155	BP	ND	0.8	0.4	4
156	BP	ND	0.8	0.4	4
157	BP	ND	0.8	0.4	4
158	BP	0.9	.	0.9	8
159	CF	1.6	.	1.6	9
160	CF	2.8	.	2.8	10
161	CF	3.4	.	3.4	11
162	CF	3.9	.	3.9	12

Table C-3

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bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Anthracene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 2

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Anthracene -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	68.57	0.0001
Error	10	14.00000000	1.40000000		
Corrected Total	11	110.00000000			

R-Square	C.V.	Root MSE	RCONC Mean
0.872727	18.20332	1.1832160	6.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	68.57	0.0001
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	68.57	0.0001

Table C-3 (Continued)

16:40 Thursday, October 5, 1989

bdad
Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Anthracene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 1.4
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.333333

Number of Means 2
Critical Range 1.612

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.500	8	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 4

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benz(a)anthracene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 5

bdat
Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benz(a)anthracene -----

General Linear Models Procedure

Dependent Variable: RCONC		RANK FOR VARIABLE CONC			
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	23.13	0.0007
Error	10	41.50000000	4.15000000		
Corrected Total	11	137.50000000			
R-Square		C.V.	Root MSE	RCONC Mean	
0.698182		31.34084	2.0371549	6.50000000	
Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	23.13	0.0007
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	23.13	0.0007

Table C-3 (Continued)

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bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benz(a)anthracene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 4.15

WARNING: Cell sizes are not equal.

Harmonic Mean of cell sizes= 5.333333

Number of Means 2

Critical Range 2.775

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.500	8	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989

7

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benzene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BF CF

Number of observations in by group = 10

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 8

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benzene -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	60.00000000	60.00000000	27.43	0.0008
Error	8	17.50000000	2.18750000		
Corrected Total	9	77.50000000			

R-Square	C.V.	Root MSE	RCONC Mean
0.774194	26.89127	1.4790199	5.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	60.00000000	60.00000000	27.43	0.0008
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	60.00000000	60.00000000	27.43	0.0008

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 7

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benzene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 8 MSE= 2.1875
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 4.8

Number of Means 2
Critical Range 2.199

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	7.500	6	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 10

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benzo(a)pyrene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

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bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benzo(a)pyrene -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	26.30	0.0004
Error	10	36.50000000	3.65000000		
Corrected Total	11	132.50000000			

R-Square	C.V.	Root MSE	RCONC Mean
0.724528	29.39227	1.9104973	6.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	26.30	0.0004
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	26.30	0.0004

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 12

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Benzo(a)pyrene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 3.65

WARNING: Cell sizes are not equal.

Harmonic Mean of cell sizes= 5.333333

Number of Means 2

Critical Range 2.602

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.500	8	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 13

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Bis(2-ethylhexyl)phthalate -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
-------	--------	--------

SOURCE	2	BP CF
--------	---	-------

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 14

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Bis(2-ethylhexyl)phthalate -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	39.18	0.0001
Error	10	24.50000000	2.45000000		
Corrected Total	11	120.50000000			

R-Square	C.V.	Root MSE	RCONC Mean
0.796680	24.08073	1.5652476	6.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	39.18	0.0001
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	39.18	0.0001

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 15

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Bis(2-ethylhexyl)phthalate -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 2.45
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.333333

Number of Means 2
Critical Range 2.132

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.500	8	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 16

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Chrysene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 17

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Chrysene -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	84.37500000	84.37500000	14.90	0.0032
Error	10	56.62500000	5.66250000		
Corrected Total	11	141.00000000			

R-Square	C.V.	Root MSE	RCONC Mean
0.598404	36.60924	2.3796008	6.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	84.37500000	84.37500000	14.90	0.0032
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	84.37500000	84.37500000	14.90	0.0032

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 18

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Chrysene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 5.6625
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.333333

Number of Means 2
Critical Range 3.241

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.375	8	BP
B	2.750	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 19

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Di-n-butyl phthalate -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 20

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Di-n-butyl phthalate -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	99999.99	0.0
Error	10	0.00000000	0.00000000		
Corrected Total	11	96.00000000			

R-Square	C.V.	Root MSE	RCONC Mean
1.000000	0	0	6.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	99999.99	0.0
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	99999.99	0.0

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 21

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Di-n-butyl phthalate -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 0

WARNING: Cell sizes are not equal.

Harmonic Mean of cell sizes= 5.333333

Number of Means 2

Critical Range 0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.500	8	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 22

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Ethylbenzene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 10

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 23

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Ethylbenzene -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	60.00000000	60.00000000	24.00	0.0012
Error	8	20.00000000	2.50000000		
Corrected Total	9	80.00000000			

R-Square	C.V.	Root MSE	RCONC Mean
0.750000	28.74798	1.5811388	5.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	60.00000000	60.00000000	24.00	0.0012
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	60.00000000	60.00000000	24.00	0.0012

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 24

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Ethylbenzene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 8 MSE= 2.5
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 4.8

Number of Means 2
Critical Range 2.351

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	7.500	6	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 25

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Phenanthrene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 26

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Phenanthrene -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	20.43	0.0011
Error	10	47.00000000	4.70000000		
Corrected Total	11	143.00000000			

R-Square	C.V.	Root MSE	RCONC Mean
0.671329	33.35305	2.1679483	6.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	20.43	0.0011
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	20.43	0.0011

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 27

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Phenanthrene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 4.7
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.333333

Number of Means 2
Critical Range 2.953

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.500	8	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 28

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Phenol -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 29

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Phenol -----

General Linear Models Procedure

Dependent Variable: RCONC		RANK FOR VARIABLE CONC			
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	33.10	0.0002
Error	10	29.00000000	2.90000000		
Corrected Total	11	125.00000000			
R-Square		C.V.	Root MSE	RCONC Mean	
0.768000		26.19906	1.7029386	6.50000000	
Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	33.10	0.0002
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	33.10	0.0002

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 30

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Phenol -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 2.9
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.333333

Number of Means 2
Critical Range 2.319

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	10.500	4	CF
B	4.500	8	BP

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 31

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Pyrene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 33

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Pyrene -----

General Linear Models Procedure

Dependent Variable: RCONC		RANK FOR VARIABLE CONC				
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	1	73.50000000	73.50000000	11.05	0.0077	
Error	10	66.50000000	6.65000000			
Corrected Total	11	140.00000000				
	R-Square	C.V.	Root MSE		RCONC Mean	
	0.525000	39.67322	2.5787594		6.50000000	
Source	DF	Type I SS	Mean Square	F Value	Pr > F	
SOURCE	1	73.50000000	73.50000000	11.05	0.0077	
Source	DF	Type III SS	Mean Square	F Value	Pr > F	
SOURCE	1	73.50000000	73.50000000	11.05	0.0077	

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 33

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Pyrene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 6.65
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.333333

Number of Means 2
Critical Range 3.512

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.250	8	BP
B	3.000	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 34

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Toluene -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BF CF

Number of observations in by group = 10

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 35

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Toluene -----

General Linear Models Procedure

Dependent Variable: RCONC RANK FOR VARIABLE CONC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	60.00000000	60.00000000	27.43	0.0008
Error	8	17.50000000	2.18750000		
Corrected Total	9	77.50000000			

R-Square	C.V.	Root MSE	RCONC Mean
0.774194	26.89127	1.4790199	5.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	60.00000000	60.00000000	27.43	0.0008
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	60.00000000	60.00000000	27.43	0.0008

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 36

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=Toluene -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 8 MSE= 2.1875
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 4.8

Number of Means 2
Critical Range 2.199

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	7.500	6	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 37

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=o-Cresol -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 38

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=o-Cresol -----

General Linear Models Procedure

Dependent Variable: RCONC		RANK FOR VARIABLE CONC			
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	99999.99	0.0
Error	10	0.00000000	0.00000000		
Corrected Total	11	96.00000000			

R-Square	C.V.	Root MSE	RCONC Mean
1.000000	0	0	6.50000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	99999.99	0.0

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	99999.99	0.0

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 39

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=o-Cresol -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCOND

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 0

WARNING: Cell sizes are not equal.

Harmonic Mean of cell sizes= 5.333333

Number of Means 2

Critical Range 0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	8.500	8	BP
B	2.500	4	CF

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 40

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=p-Cresol -----

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	2	BP CF

Number of observations in by group = 12

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 41

bdat
Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=p-Cresol -----

General Linear Models Procedure

Dependent Variable: RCONC		RANK FOR VARIABLE CONC			
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	96.00000000	96.00000000	50.53	0.0001
Error	10	19.00000000	1.90000000		
Corrected Total	11	115.00000000			
R-Square		C.V.	Root MSE	RCONC Mean	
0.834783		21.20623	1.3784049	6.50000000	
Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	50.53	0.0001
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	1	96.00000000	96.00000000	50.53	0.0001

Table C-3 (Continued)

16:40 Thursday, October 5, 1989 42

bdat

Comparison of Two Zones by Analyte Using ANOVA
Nonparametric Approach

----- ANALYTE=p-Cresol -----

General Linear Models Procedure

Duncan's Multiple Range Test for variable: RCONC

NOTE: This test controls the type I comparisonwise error rate, not
the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 1.9
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.333333

Number of Means 2
Critical Range 1.877

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SOURCE
A	10.500	4	CF
B	4.500	8	BP

Appendix D

DETECTION LIMITS FOR UNTREATED AND TREATED WASTES

TABLE D-1

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

DETECTION LIMITS				
BDAT LIST CONSTITUENT	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
VOLATILE ORGANICS				
222. Acetone	5	10	10	6.3
1. Acetonitrile	50	100	100	63
2. Acrolein	25	50	50	31
3. Acrylonitrile	25	50	50	31
4. Benzene	2.5	5	5	3.1
5. Bromodichloromethane	2.5	5	5	3.1
6. Bromomethane	5	10	10	6.3
223. n-Butyl alcohol	100	200	200	125
7. Carbon tetrachloride	2.5	5	5	3.1
8. Carbon disulfide	2.5	5	5	3.1
9. Chlorobenzene	2.5	5	5	3.1
10. 2-Chloro-1,3-butadiene (chloroprene)	2.5	5	5	3.1
11. Chlorodibromomethane	5	10	10	6.3
12. Chloroethane	2.5	5	5	3.1
14. Chloroform	5	10	10	6.3
15. Chloromethane	2.5	5	5	3.1
16. 3-Chloropropene (allyl chloride)	5	10	10	6.3
17. 1,2-Dibromo-3-chloropropane	2.5	5	5	3.1
18. 1,2-Dibromoethane	2.5	5	5	3.1
19. Dibromomethane (methylene bromide)	5	10	10	6.3
20. Trans-1,4-dichloro-2-butene	5	10	10	6.3
21. Dichlorodifluoromethane	2.5	5	5	3.1
22. 1,1-Dichloroethane	2.5	5	5	3.1
23. 1,2-Dichloroethane	2.5	5	5	3.1
24. 1,1-Dichloroethylene	3.1	3.1	3.1	3.1
25. Trans-1,2-dichloroethene	2.5	5	5	3.1
26. 1,2-Dichloropropane	2.5	5	5	31
27. Trans-1,3-dichloropropene	2.5	5	5	3.1
28. cis-1,3-Dichloropropene	100	200	200	130
29. 1,4-Dioxane	10	20	20	13
225. Ethyl acetate	2.5	5	5	3.1
226. Ethyl benzene				

TABLE D-1 (Continued)

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
VOLATILE ORGANICS (Continued)				
30. Ethyl cyanide (propionitrile)	2.5	5	5	3.1
227. Ethyl ether	2.5	5	5	3.1
31. Ethyl methacrylate	2.5	5	5	3.1
32. Iodomethane	2.5	5	5	3.1
33. Isobutyl alcohol	250	500	500	310
34. Methyl ethyl ketone	5	10	10	6.3
229. Methyl isobutyl ketone	5	10	10	6.3
35. Methyl methacrylate	2.5	5	5	3.1
37. Methylacrylonitrile	2.5	5	5	3.1
38. Methylene chloride	2.5	5	5	3.1
39. Pyridine	130	250	250	160
40. 1,1,1,2-Tetrachloroethane	2.5	5	5	3.1
41. 1,1,2,2-Tetrachloroethane	2.5	5	5	3.1
42. Tetrachloroethene	2.5	5	5	3.1
43. Toluene	2.5	5	5	3.1
44. Tribromomethane (bromoform)	2.5	5	5	3.1
45. 1,1,1-Trichloroethane	2.5	5	5	3.1
46. 1,1,2-Trichloroethane	2.5	5	5	3.1
47. Trichloroethene	2.5	5	5	3.1
48. Trichloromonofluoromethane	2.5	5	5	3.1
49. 1,2,3-Trichloropropane	2.5	5	5	3.1
231. 1,1,2-Trichloro-1,2,2-trifluoroethane	2.5	5	5	3.1
50. Vinyl chloride	5	10	10	6.3
215.-217. Xylenes (total)	2.5	5	5	3.1
* 2-Nitropropane	10	20	20	13
* Styrene	2.5	5	5	3.1
* 2-Hexanone	5	10	10	6.3
* Vinyl acetate	5	10	10	6.3
* 1,2-Dichloroethene (total)	2.5	5	5	3.1

* Not a BDAT List constituent.

TABLE D-1 (Continued)

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
SEMIVOLATILE ORGANICS				
51. Acenaphthalene	1.36	1.28	2.72	1.36
52. Acenaphthene	1.36	1.28	2.72	1.36
53. Acetophenone	1.36	1.28	2.72	1.36
54. 2-Acetylaminofluorene	1.36	1.28	2.72	1.36
233. Acrylamide	1.36	1.28	2.72	1.36
55. 4-Aminobiphenyl	1.36	1.28	2.72	1.36
56. Aniline	1.36	1.28	2.72	1.36
57. Anthracene	1.36	1.28	2.72	1.36
58. Aramite	1.36	1.28	2.72	1.36
59. Benz(a)anthracene	1.36	1.28	2.72	1.36
218. Benzal chloride	1.36	1.28	2.72	1.36
60. Benzenethiol	1.36	1.28	2.72	1.36
62. Benzo(a)pyrene	1.36	1.28	2.72	1.36
63. Benzo(b)fluoranthene	1.36	1.28	2.72	1.36
64. Benzo(g,h,i)perylene	1.36	1.28	2.72	1.36
65. Benzo(k)fluoranthene	1.36	1.28	2.72	1.36
66. p-Benzoquinone	1.36	1.28	2.72	1.36
67. Bis(2-chloroethoxy)methane	1.36	1.28	2.72	1.36
68. Bis(2-chloroethyl)ether	1.36	1.28	2.72	1.36
69. Bis(2-chloroisopropyl)ether	1.36	1.28	2.72	1.36
71. 4-Bromophenyl phenyl ether	1.36	1.28	2.72	1.36
70. Bis(2-ethylhexyl)phthalate	1.36	1.28	2.72	1.36
72. Butyl benzyl phthalate	1.36	1.28	2.72	1.36
73. 2-sec-butyl-4,6-Dinitrophenol (dinoseb)	1.36	1.28	2.72	1.36
74. p-Chloroaniline	1.36	1.28	2.72	1.36
75. Chlorobenzilate	1.36	1.28	2.72	1.36
76. p-Chloro-m-cresol	1.36	1.28	2.72	1.36
77. 2-Chloronaphthalene	1.36	1.28	2.72	1.36
78. 2-Chlorophenol	1.36	1.28	2.72	1.36
80. Chrysene	1.36	1.28	2.72	1.36
81. ortho-Cresol	1.36	1.28	2.72	1.36
82. para-Cresol	1.36	1.28	2.72	1.36
232. Cyclohexanone	100	200	200	125

TABLE D-1 (Continued)

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
SEMIVOLATILE ORGANICS (Continued)				
83. Dibenzo(a,h)anthracene	1.36	1.28	2.72	1.36
84. Dibenzo(a,e)pyrene	1.36	1.28	2.72	1.36
86. m-Dichlorobenzene	1.36	1.28	2.72	1.36
87. o-Dichlorobenzene	1.36	1.28	2.72	1.36
88. p-Dichlorobenzene	1.36	1.28	2.72	1.36
89. 3,3'-Dichlorobenzidine	2.72	2.56	5.44	2.72
90. 2,4-Dichlorophenol	1.36	1.28	2.72	1.36
91. 2,6-Dichlorophenol	1.36	1.28	2.72	1.36
92. Diethyl phthalate	1.36	1.28	2.72	1.36
93. 3,3'-Dimethoxybenzidine	1.36	1.28	5.44	1.36
94. p-Dimethylaminoazobenzene	1.36	1.28	2.72	1.36
95. 3,3'-Dimethylbenzidine	1.36	1.28	2.72	1.36
96. 2,4-Dimethylphenol	1.36	1.28	2.72	1.36
98. Di-n-butyl phthalate	1.36	1.28	2.72	1.36
97. Dimethyl phthalate	1.36	1.28	2.72	1.36
99. 1,4-Dinitrobenzene	1.36	1.28	2.72	1.36
100. 4,6-Dinitro-o-cresol	6.8	6.4	13.6	6.8
101. 2,4-Dinitrophenol	6.8	6.4	13.6	6.8
102. 2,4-Dinitrotoluene	1.36	1.28	2.72	1.36
103. 2,6-Dinitrotoluene	1.36	1.28	2.72	1.36
104. Di-n-octyl phthalate	1.36	1.28	2.72	1.36
105. Di-n-propylnitrosamine	1.36	1.28	2.72	1.36
106. Diphenylamine	1.36	1.28	2.72	1.36
219. Diphenylnitrosamine	1.36	1.28	2.72	1.36
107. 1,2-Diphenylhydrazine	1.36	1.28	2.72	1.36
108. Fluoranthene	1.36	1.28	2.72	1.36
109. Fluorene	1.36	1.28	2.72	1.36
110. Hexachlorobenzene	1.36	1.28	2.72	1.36
111. Hexachlorobutadiene	1.36	1.28	2.72	1.36
112. Hexachlorocyclopentadiene	1.36	1.28	2.72	1.36
113. Hexachloroethane	1.36	1.28	2.72	1.36
115. Hexachloropropene	1.36	1.28	2.72	1.36
116. Indeno(1,2,3-cd)pyrene	1.36	1.28	2.72	1.36
117. Isosafrole	1.36	1.28	2.72	1.36
118. Methapyrilene	1.36	1.28	2.72	1.36
119. 3-Methylcholanthrene	1.36	1.28	2.72	1.36
120. 4,4'-Methylenebis(2-chloroaniline)	1.36	1.28	2.72	1.36

TABLE D-1 (Continued)

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
SEMIVOLATILE ORGANICS (Continued)				
36. Methyl methanesulfonate	1.36	1.28	2.72	1.36
121. Naphthalene	1.36	1.28	2.72	1.36
122. 1,4-Naphthoquinone	1.36	1.28	2.72	1.36
123. 1-Naphthylamine	1.36	1.28	2.72	1.36
124. 2-Naphthylamine	1.36	1.28	2.72	1.36
125. p-Nitroaniline	6.8	6.4	13.6	6.8
126. Nitrobenzene	1.36	1.28	2.72	1.36
127. 4-Nitrophenol	6.8	6.4	13.6	6.8
128. N-Nitrosodi-n-butylamine	1.36	1.28	2.72	1.36
129. N-Nitrosodiethylamine	1.36	1.28	2.72	1.36
130. N-Nitrosodimethylamine	1.36	1.28	2.72	1.36
131. N-Nitrosomethylethylamine	1.36	1.28	2.72	1.36
132. N-Nitrosomorpholine	1.36	1.28	2.72	1.36
133. N-Nitrosopiperidine	1.36	1.28	2.72	1.36
135. 5-Nitro-o-Toluidine	1.36	1.28	2.72	1.36
134. N-Nitrosopyrrolidine	1.36	1.28	2.72	1.36
136. Pentachlorobenzene	1.36	1.28	2.72	1.36
137. Pentachloroethane	2.5	5	5	3.1
138. Pentachloronitrobenzene	1.36	1.28	2.72	1.36
139. Pentachlorophenol	6.8	6.4	13.6	6.8
140. Phenacetin	1.36	1.28	2.72	1.36
141. Phenanthrene	1.36	1.28	2.72	1.36
142. Phenol	1.36	1.28	2.72	1.36
220. Phthalic anhydride	1.36	1.28	2.72	1.36
144. Pronamide	1.36	1.28	2.72	1.36
145. Pyrene	1.36	1.28	2.72	1.36
146. Resorcinol	1.36	1.28	2.72	1.36
147. Safrole	1.36	1.28	2.72	1.36
148. 1,2,4,5-Tetrachlorobenzene	1.36	1.28	2.72	1.36
149. 2,3,4,6-Tetrachlorophenol	1.36	1.28	2.72	1.36
150. 1,2,4-Trichlorobenzene	1.36	1.28	2.72	1.36
151. 2,4,5-Trichlorophenol	6.8	6.4	13.6	6.8
152. 2,4,6-Trichlorophenol	1.36	1.28	2.72	1.36
153. Tris(2,3-dibromopropyl) phosphate	1.36	1.28	2.72	1.36
* sym-Trinitrobenzene	1.36	1.28	2.72	1.36
* 4-Nitroquinoline-1-oxide	1.36	1.28	2.72	1.36

* Not a BDAT List constituent.

TABLE D-1 (Continued)

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
SEMIVOLATILE ORGANICS (Continued)				
* m-Dinitrobenzene	1.36	1.28	2.72	1.36
* p-Phenylenediamine	1.36	1.28	2.72	1.36
* m-Cresol	1.36	1.28	2.72	1.36
* 2-Methylnaphthalene	1.36	1.28	2.72	1.36
* a,a-Dimethylphenethylamine	1.36	1.28	2.72	1.36
* 2-Picoline	1.36	1.28	2.72	1.36
* 3-Nitroaniline	6.8	6.4	13.6	6.8
* o-Toluidine	1.36	1.28	2.72	1.36
* 2-Nitroaniline	6.8	6.4	13.6	6.8
* Benzyl alcohol	1.36	1.28	2.72	1.36
* Ethyl methanesulfonate	1.36	1.28	2.72	1.36
* Benzoic acid	6.8	6.4	13.6	6.8
* Dibenzofuran	1.36	1.28	2.72	1.36
* 2-Nitrophenol	1.36	1.28	2.72	1.36
* 7,12-Dimethylbenz(a)anthracene	1.36	1.28	2.72	1.36
* Isophorone	1.36	1.28	2.72	1.36
* 4-Chlorophenyl-phenyl ether	1.36	1.28	2.72	1.36
METALS				
154. Antimony	2.8	2.8	2.8	2.4
155. Arsenic	1	1	1	1
156. Barium	0.2	0.2	0.2	0.1
157. Beryllium	0.2	0.2	0.2	0.1
158. Cadmium	0.5	0.5	0.5	0.5
159. Chromium (total)	0.7	0.7	0.7	0.3
160. Copper	0.3	0.3	0.3	0.3
161. Lead	50	5	50	2.8
162. Mercury	0.02	0.02	0.02	0.0002
163. Nickel	1.3	1.3	1.3	1
164. Selenium	2	0.5	2	0.3
165. Silver	0.4	0.4	0.4	0.4
166. Thallium	1	1	1	1
167. Vanadium	0.3	0.3	0.3	0.3
168. Zinc	0.3	0.3	0.3	0.2

* Not a BDAT List constituent.

TABLE D-1 (Continued)

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BOAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
TCLP METALS				
154. Antimony	NA	NA	0.028	NA
155. Arsenic	NA	NA	0.005	NA
156. Barium	NA	NA	0.002	NA
157. Beryllium	NA	NA	0.002	NA
158. Cadmium	NA	NA	0.005	NA
159. Chromium (total)	NA	NA	0.007	NA
221. Chromium (hexavalent)	0.01	0.01	0.01	0.01
160. Copper	NA	NA	0.003	NA
161. Lead	NA	NA	0.005	NA
162. Mercury	NA	NA	0.0002	NA
163. Nickel	NA	NA	0.013	NA
164. Selenium	NA	NA	0.005	NA
165. Silver	NA	NA	0.004	NA
166. Thallium	NA	NA	0.01	NA
167. Vanadium	NA	NA	0.003	NA
168. Zinc	NA	NA	0.003	NA
CA WASTE EXTRACTION METALS				
154. Antimony	0.028	0.028	0.028	0.028
155. Arsenic	0.03	0.03	0.03	0.03
156. Barium	0.002	0.002	0.002	0.002
157. Beryllium	0.002	0.002	0.002	0.002
158. Cadmium	0.005	0.005	0.005	0.004
159. Chromium (total)	0.007	0.007	0.007	0.007
221. Chromium (hexavalent)	0.01	0.01	0.01	0.01
160. Copper	0.003	0.003	0.003	0.003
161. Lead	0.028	0.028	0.028	0.019
162. Mercury	0.002	0.002	0.002	0.0002
163. Nickel	0.013	0.013	0.013	0.013
164. Selenium	0.05	0.05	0.05	0.005

NA Not analyzed.

TABLE D-1 (Continued)

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

=====				
DETECTION LIMITS				
BDAT LIST CONSTITUENT	Sample	Sample	Sample	Sample
	Set #1	Set #2	Set #3	Set #4
	(ppm)	(ppm)	(ppm)	(ppm)

CA WASTE EXTRACTION METALS (Continued)				

165. Silver	0.004	0.004	0.004	0.003
166. Thallium	0.02	0.02	0.05	0.01
167. Vanadium	0.003	0.003	0.003	0.003
168. Zinc	0.003	0.003	0.003	0.003
* Cobalt	0.006	0.006	0.006	0.006
* Molybdenum	0.006	0.006	0.006	0.006
INORGANICS				

169. Cyanide	0.49	0.5	0.49	0.46
170. Fluoride	NA	NA	0.28	NA
171. Sulfide	NA	NA	5	NA
PCBs				

200. Aroclor 1016	NA	NA	NA	0.88
201. Aroclor 1221	NA	NA	NA	0.88
202. Aroclor 1232	NA	NA	NA	0.88
203. Aroclor 1242	NA	NA	NA	0.88
204. Aroclor 1248	NA	NA	NA	0.88
205. Aroclor 1254	NA	NA	NA	0.88
206. Aroclor 1260	NA	NA	NA	0.88
DIOXINS AND FURANS				

207. Hexachlorodibenzo-p-dioxins	0.0007	0.0008	0.0011	0.0006
208. Hexachlorodibenzofurans	0.0004	0.0004	0.0006	0.0004
209. Pentachlorodibenzo-p-dioxins	0.0007	0.0008	0.0009	0.0006
210. Pentachlorodibenzofurans	0.0005	0.0005	0.0006	0.0004

NA Not analyzed.

* Not a BDAT List constituent.

TABLE D-1 (Continued)

DETECTION LIMITS FOR THE K048 AND K051 FEED SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
DIOXINS AND FURANS (Continued)				
211. Tetrachlorodibenzo-p-dioxins	0.0019	0.0022	0.0022	0.0013
212. Tetrachlorodibenzofurans	NR	0.0011	0.0012	0.0019
213. 2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.0016	0.0021	0.0021	0.0012

NR Not reported.

TABLE D-2

DETECTION LIMITS FOR THE RAFFINATE SOLIDS SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
VOLATILE ORGANICS				
222. Acetone	0.1	0.1	0.1	0.1
1. Acetonitrile	1	1	1	1
2. Acrolein	0.5	0.5	0.5	0.5
3. Acrylonitrile	0.5	0.5	0.5	0.5
4. Benzene	0.05	0.05	0.05	0.05
5. Bromodichloromethane	0.05	0.05	0.05	0.05
6. Bromomethane	0.1	0.1	0.1	0.1
223. n-Butyl alcohol	2	2	2	2
7. Carbon tetrachloride	0.05	0.05	0.05	0.05
8. Carbon disulfide	0.05	0.05	0.05	0.05
9. Chlorobenzene	0.05	0.05	0.05	0.05
10. 2-Chloro-1,3-butadiene	0.05	0.05	0.05	0.05
11. Chlorodibromomethane	0.05	0.05	0.05	0.05
12. Chloroethane	0.1	0.1	0.1	0.1
14. Chloroform	0.05	0.05	0.05	0.05
15. Chloromethane	0.1	0.1	0.1	0.1
16. 3-Chloropropene	0.05	0.05	0.05	0.05
17. 1,2-Dibromo-3-chloropropane	0.1	0.1	0.1	0.1
18. 1,2-Dibromoethane	0.05	0.05	0.05	0.05
19. Dibromomethane	0.05	0.05	0.05	0.05
20. Trans-1,4-dichloro-2-butene	0.1	0.1	0.1	0.1
21. Dichlorodifluoromethane	0.1	0.1	0.1	0.1
22. 1,1-Dichloroethane	0.05	0.05	0.05	0.05
23. 1,2-Dichloroethane	0.05	0.05	0.05	0.05
24. 1,1-Dichloroethylene	0.05	0.05	0.05	0.05
26. 1,2-Dichloropropane	0.05	0.05	0.05	0.05
27. Trans-1,3-dichloropropene	0.05	0.05	0.05	0.05
28. cis-1,3-Dichloropropene	0.05	0.05	0.05	0.05
29. 1,4-Dioxane	2	2	2	2
225. Ethyl acetate	0.2	0.2	0.2	0.2
226. Ethyl benzene	0.05	0.05	0.05	0.05
30. Ethyl cyanide	0.05	0.05	0.05	0.05
227. Ethyl ether	0.05	0.05	0.05	0.05
31. Ethyl methacrylate	0.05	0.05	0.05	0.05

TABLE D-2 (Continued)

DETECTION LIMITS FOR THE RAFFINATE SOLIDS SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
VOLATILE ORGANICS (Continued)				
32. Iodomethane	0.05	0.05	0.05	0.05
33. Isobutyl alcohol	5	5	5	5
34. Methyl ethyl ketone	0.1	0.1	0.1	0.1
229. Methyl isobutyl ketone	0.1	0.1	0.1	0.1
35. Methyl methacrylate	0.05	0.05	0.05	0.05
37. Methylacrylonitrile	0.05	0.05	0.05	0.05
38. Methylene chloride	0.05	0.05	0.05	0.05
39. Pyridine	2.5	2.5	2.5	2.5
40. 1,1,1,2-Tetrachloroethane	0.05	0.05	0.05	0.05
41. 1,1,2,2-Tetrachloroethane	0.05	0.05	0.05	0.05
42. Tetrachloroethene	0.05	0.05	0.05	0.05
43. Toluene	0.05	0.05	0.05	0.05
44. Tribromomethane	0.05	0.05	0.05	0.05
45. 1,1,1-Trichloroethane	0.05	0.05	0.05	0.05
46. 1,1,2-Trichloroethane	0.05	0.05	0.05	0.05
47. Trichloroethene	0.05	0.05	0.05	0.05
48. Trichloromonofluoromethane	0.05	0.05	0.05	0.05
49. 1,2,3-Trichloropropane	0.05	0.05	0.05	0.05
231. 1,1,2-Trichloro-1,2,2-trifluoroethane	0.05	0.05	0.05	0.05
50. Vinyl chloride	0.1	0.1	0.1	0.1
215.-217. Xylenes (total)	0.05	0.05	0.05	0.05
* 2-Nitropropane	0.2	0.2	0.2	0.2
* Styrene	0.05	0.05	0.05	0.05
* 2-Hexanone	0.1	0.1	0.1	0.1
* Vinyl acetate	0.1	0.1	0.1	0.1
* 1,2-Dichloroethene (total)	0.05	0.05	0.05	0.05
* 2-Ethoxyethanol	0.05	0.05	0.05	0.05
SEMIVOLATILE ORGANICS				
51. Acenaphthalene	0.33	0.33	0.33	0.33
52. Acenaphthene	0.33	0.33	0.33	0.33
53. Acetophenone	0.33	0.33	0.33	0.33
54. 2-Acetylaminofluorene	0.33	0.33	0.33	0.33
55. 4-Aminobiphenyl	0.33	0.33	0.33	0.33

* Not a BDAT List constituent.

TABLE D-2 (Continued)

DETECTION LIMITS FOR THE RAFFINATE SOLIDS SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
SEMIVOLATILE ORGANICS (Continued)				
56. Aniline	0.33	0.33	0.33	0.33
57. Anthracene	0.33	0.33	0.33	0.33
58. Aramite	0.33	0.33	0.33	0.33
59. Benz(a)anthracene	0.33	0.33	0.33	0.33
62. Benzo(a)pyrene	0.33	0.33	0.33	0.33
63. Benzo(b)fluoranthene	0.33	0.33	0.33	0.33
64. Benzo(g,h,i)perylene	0.33	0.33	0.33	0.33
65. Benzo(k)fluoranthene	0.33	0.33	0.33	0.33
67. Bis(2-chloroethoxy)methane	0.33	0.33	0.33	0.33
68. Bis(2-chloroethyl)ether	0.33	0.33	0.33	0.33
69. Bis(2-chloroisopropyl)ether	0.33	0.33	0.33	0.33
71. 4-Bromophenyl phenyl ether	0.33	0.33	0.33	0.33
70. Bis(2-ethylhexyl)phthalate	0.33	0.33	0.33	0.33
72. Butyl benzyl phthalate	0.33	0.33	0.33	0.33
73. 2-sec-butyl-4,6-Dinitrophenol	0.33	0.33	0.33	0.33
74. p-Chloroaniline	0.33	0.33	0.33	0.33
75. Chlorobenzilate	0.33	0.33	0.33	0.33
76. p-Chloro-m-cresol	0.33	0.33	0.33	0.33
77. 2-Chloronaphthalene	0.33	0.33	0.33	0.33
78. 2-Chlorophenol	0.33	0.33	0.33	0.33
80. Chrysene	0.33	0.33	0.33	0.33
81. ortho-Cresol	0.33	0.33	0.33	0.33
82. para-Cresol	0.33	0.33	0.33	0.33
232. Cyclohexanone	2	2	2	2
83. Dibenzo(a,h)anthracene	0.33	0.33	0.33	0.33
86. m-Dichlorobenzene	0.33	0.33	0.33	0.33
87. o-Dichlorobenzene	0.33	0.33	0.33	0.33
88. p-Dichlorobenzene	0.33	0.33	0.33	0.33
89. 3,3'-Dichlorobenzidine	0.66	0.66	0.66	0.66
90. 2,4-Dichlorophenol	0.33	0.33	0.33	0.33
91. 2,6-Dichlorophenol	0.33	0.33	0.33	0.33
92. Diethyl phthalate	0.33	0.33	0.33	0.33

TABLE D-2 (Continued)

DETECTION LIMITS FOR THE RAFFINATE SOLIDS SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
SEMIVOLATILE ORGANICS (Continued)				
94. p-Dimethylaminoazobenzene	0.33	0.33	0.33	0.33
95. 3,3'-Dimethylbenzidine	0.33	0.33	0.33	0.33
96. 2,4-Dimethylphenol	0.33	0.33	0.33	0.33
97. Dimethyl phthalate	0.33	0.33	0.33	0.33
98. Di-n-butyl phthalate	0.33	0.33	0.33	0.33
99. 1,4-Dinitrobenzene	0.33	0.33	0.33	0.33
100. 4,6-Dinitro-o-cresol	1.6	1.6	1.6	1.6
101. 2,4-Dinitrophenol	1.6	1.6	1.6	1.6
102. 2,4-Dinitrotoluene	0.33	0.33	0.33	0.33
103. 2,6-Dinitrotoluene	0.33	0.33	0.33	0.33
104. Di-n-octyl phthalate	0.33	0.33	0.33	0.33
105. Di-n-propylnitrosamine	0.33	0.33	0.33	0.33
106. Diphenylamine	0.33	0.33	0.33	0.33
219. Diphenylnitrosamine	0.33	0.33	0.33	0.33
108. Fluoranthene	0.33	0.33	0.33	0.33
109. Fluorene	0.33	0.33	0.33	0.33
110. Hexachlorobenzene	0.33	0.33	0.33	0.33
111. Hexachlorobutadiene	0.33	0.33	0.33	0.33
112. Hexachlorocyclopentadiene	0.33	0.33	0.33	0.33
113. Hexachloroethane	0.33	0.33	0.33	0.33
115. Hexachloropropene	0.33	0.33	0.33	0.33
116. Indeno(1,2,3-cd)pyrene	0.33	0.33	0.33	0.33
117. Isosafrole	0.33	0.33	0.33	0.33
118. Methapyrilene	0.33	0.33	0.33	0.33
119. 3-Methylcholanthrene	0.33	0.33	0.33	0.33
120. 4,4'-Methylenebis(2-chloroaniline)	0.33	0.33	0.33	0.33
36. Methyl methanesulfonate	0.33	0.33	0.33	0.33
121. Naphthalene	0.33	0.33	0.33	0.33
122. 1,4-Naphthoquinone	0.33	0.33	0.33	0.33
123. 1-Naphthylamine	0.33	0.33	0.33	0.33
124. 2-Naphthylamine	0.33	0.33	0.33	0.33
125. p-Nitroaniline	1.6	1.6	1.6	1.6
126. Nitrobenzene	0.33	0.33	0.33	0.33
127. 4-Nitrophenol	1.6	1.6	1.6	1.6
128. N-Nitrosodi-n-butylamine	0.33	0.33	0.33	0.33
129. N-Nitrosodiethylamine	0.33	0.33	0.33	0.33
130. N-Nitrosodimethylamine	0.33	0.33	0.33	0.33

TABLE D-2 (Continued)

DETECTION LIMITS FOR THE RAFFINATE SOLIDS SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
SEMIVOLATILE ORGANICS (Continued)				
131. N-Nitrosomethylethylamine	0.33	0.33	0.33	0.33
132. N-Nitrosomorpholine	0.33	0.33	0.33	0.33
133. N-Nitrosopiperidine	0.33	0.33	0.33	0.33
135. 5-Nitro-o-Toluidine	0.33	0.33	0.33	0.33
134. N-Nitrosopyrrolidine	0.33	0.33	0.33	0.33
136. Pentachlorobenzene	0.33	0.33	0.33	0.33
137. Pentachloroethane	0.05	0.05	0.05	0.05
138. Pentachloronitrobenzene	0.33	0.33	0.33	0.33
139. Pentachlorophenol	1.6	1.6	1.6	1.6
140. Phenacetin	0.33	0.33	0.33	0.33
141. Phenanthrene	0.33	0.33	0.33	0.33
142. Phenol	0.33	0.33	0.33	0.33
144. Pronamide	0.33	0.33	0.33	0.33
145. Pyrene	0.33	0.33	0.33	0.33
147. Safrole	0.33	0.33	0.33	0.33
148. 1,2,4,5-Tetrachlorobenzene	0.33	0.33	0.33	0.33
149. 2,3,4,6-Tetrachlorophenol	0.33	0.33	0.33	0.33
150. 1,2,4-Trichlorobenzene	0.33	0.33	0.33	0.33
151. 2,4,5-Trichlorophenol	1.6	1.6	1.6	1.6
152. 2,4,6-Trichlorophenol	0.33	0.33	0.33	0.33
* sym-Trinitrobenzene	0.33	0.33	0.33	0.33
* 4-Nitroquinoline-1-oxide	0.33	0.33	0.33	0.33
* m-Dinitrobenzene	0.33	0.33	0.33	0.33
* p-Phenylenediamine	0.33	0.33	0.33	0.33
* m-Cresol	0.33	0.33	0.33	0.33
* 2-Methylnaphthalene	0.33	0.33	0.33	0.33
* a,a-Dimethylphenethylamine	0.33	0.33	0.33	0.33
* 2-Picoline	0.33	0.33	0.33	0.33
* 3-Nitroaniline	1.6	1.6	1.6	1.6
* o-Toluidine	0.33	0.33	0.33	0.33
* 2-Nitroaniline	1.6	1.6	1.6	1.6
* Benzyl alcohol	0.33	0.33	0.33	0.33
* Ethyl methanesulfonate	0.33	0.33	0.33	0.33
* Benzoic acid	1.6	1.6	1.6	1.6
* Dibenzofuran	0.33	0.33	0.33	0.33

* Not a BDAT List constituent.

TABLE D-2 (Continued)

DETECTION LIMITS FOR THE RAFFINATE SOLIDS SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
SEMIVOLATILE ORGANICS (Continued)				
* 2-Nitrophenol	0.33	0.33	0.33	0.33
* 7,12-Dimethylbenz(a)anthracene	0.33	0.33	0.33	0.33
* Isophorone	0.33	0.33	0.33	0.33
* 4-Chlorophenyl-phenyl ether	0.33	0.33	0.33	0.33
METALS				
154. Antimony	2.4	2.4	2.4	2.4
155. Arsenic	1	1	1	1
156. Barium	0.1	0.1	0.1	0.1
157. Beryllium	0.1	0.1	0.1	0.1
158. Cadmium	0.5	0.5	0.5	0.5
159. Chromium (total)	0.3	0.3	0.3	0.3
160. Copper	0.3	0.3	0.3	0.3
161. Lead	2.8	2.8	2.8	2.8
162. Mercury	0.0002	0.0002	0.0002	0.0002
163. Nickel	1	1	1	1
164. Selenium	0.3	0.3	0.3	0.3
165. Silver	0.4	0.4	0.4	0.4
166. Thallium	1	1	1	1
167. Vanadium	0.3	0.3	0.3	0.3
168. Zinc	0.2	0.2	0.2	0.2
TCLP METALS				
154. Antimony	0.024	0.024	0.024	0.024
155. Arsenic	0.01	0.01	0.01	0.01
156. Barium	0.001	0.001	0.001	0.001
157. Beryllium	0.001	0.001	0.001	0.001
158. Cadmium	0.005	0.005	0.005	0.005
159. Chromium (total)	0.003	0.003	0.003	0.003
221. Chromium (hexavalent)	0.01	0.01	10	0.01
160. Copper	0.003	0.003	0.003	0.003

* Not a BDAT List constituent.

TABLE D-2 (Continued)

DETECTION LIMITS FOR THE RAFFINATE SOLIDS SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
TCLP METALS (Continued)				
161. Lead	0.005	0.005	0.005	0.005
162. Mercury	0.0002	0.0002	0.0002	0.0002
163. Nickel	0.01	0.01	0.01	0.01
164. Selenium	0.005	0.005	0.005	0.005
165. Silver	0.004	0.004	0.004	0.004
166. Thallium	0.01	0.01	0.01	0.01
167. Vanadium	0.003	0.003	0.003	0.003
168. Zinc	0.002	0.002	0.002	0.002
CA WASTE EXTRACTION TEST METALS				
154. Antimony	0.028	0.028	0.028	0.028
155. Arsenic	0.03	0.03	0.03	0.03
156. Barium	0.002	0.002	0.002	0.002
157. Beryllium	0.002	0.002	0.002	0.002
158. Cadmium	0.004	0.004	0.004	0.004
159. Chromium (total)	0.007	0.007	0.007	0.007
221. Chromium (hexavalent)	0.01	0.01	0.01	0.01
160. Copper	0.003	0.003	0.003	0.003
161. Lead	0.019	0.019	0.019	0.019
162. Mercury	0.0002	0.0002	0.0002	0.0002
163. Nickel	0.013	0.013	0.013	0.013
164. Selenium	0.005	0.005	0.005	0.005
165. Silver	0.003	0.003	0.003	0.003
166. Thallium	0.01	0.01	0.04	0.01
167. Vanadium	0.003	0.003	0.003	0.003
168. Zinc	0.003	0.003	0.003	0.003
* Cobalt	0.006	0.006	0.006	0.006
* Molybdenum	0.006	0.006	0.006	0.006

* Not a BDAT List constituent.

TABLE D-2 (Continued)

DETECTION LIMITS FOR THE RAFFINATE SOLIDS SAMPLES
SOLVENT EXTRACTION AT PLANT Q

BDAT LIST CONSTITUENT	DETECTION LIMITS			
	Sample Set #1 (ppm)	Sample Set #2 (ppm)	Sample Set #3 (ppm)	Sample Set #4 (ppm)
INORGANICS				
169. Cyanide	0.48	0.37	0.47	0.46
170. Fluoride	NA	NA	NR	NA
171. Sulfide	NA	NA	NR	NA
PCBs				
200. Aroclor 1016	NA	NA	NA	0.5
201. Aroclor 1221	NA	NA	NA	0.5
202. Aroclor 1232	NA	NA	NA	0.5
203. Aroclor 1242	NA	NA	NA	0.5
204. Aroclor 1248	NA	NA	NA	0.5
205. Aroclor 1254	NA	NA	NA	0.5
206. Aroclor 1260	NA	NA	NA	0.5
DIOXINS AND FURANS				
207. Hexachlorodibenzo-p-dioxins	NA	NA	NA	NA
208. Hexachlorodibenzofurans	NA	NA	NA	NA
209. Pentachlorodibenzo-p-dioxins	NA	NA	NA	NA
210. Pentachlorodibenzofurans	NA	NA	NA	NA
211. Tetrachlorodibenzo-p-dioxins	NA	NA	NA	NA
212. Tetrachlorodibenzofurans	NA	NA	NA	NA
213. 2,3,7,8-Tetrachlorodibenzo-p-dioxin	NA	NA	NA	NA

NA Not analyzed.

NR Not reported.

TABLE D-3
DETECTION LIMITS FOR CYANIDE IN THE K048 FEED SAMPLES AND
THE COMBUSTION GAS SCRUBBER DISCHARGE WATER SAMPLES
FLUIDIZED BED INCINERATION AT PLANT A

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DETECTION LIMITS FOR SAMPLE SETS 1-6		

BDAT LIST CONSTITUENT	K048 Feed Sample (ppm)	Combustion Gas Scrubber Discharge Water (ppm)
INORGANICS		

169. Cyanide	0.6	0.01